UM1510
User manual

STM32L152D-EVAL demonstration firmware

Introduction

This user manual describes the demonstration firmware running on the STM32L152D-EVAL evaluation board, which can be used to evaluate the capabilities of the STM32L152ZD(T6) microcontroller and on-board peripherals.

This demo contains many applications that can be easily reused, such as RTC calendar, file system FAT implementation on SD Card, Wave player with STM32 I2S peripheral, voice recording, automatic measure of the power consumption in several operating modes, Dual Interface EEPROM applications (ESL and DataLogger), temperature sensor interfacing and TFT LCD.

The STM32L152D-EVAL board is delivered with the demonstration programmed in the internal Flash memory, and all the files needed by the demonstration are programmed in the MicroSD card. The demonstration is executed at each reset (board power-up, external reset, etc.).

In case the STM32L152D-EVAL board was not factory-programmed or the demonstration application was erased, the Bootloader, IAP or USB DFU can be used to program this file. For more details, refer to *Section 3: STM32L152D-EVAL demonstration package* and *Section 4: STM32L152D-EVAL demonstration programming*.

Note: Before you execute the demonstration, make sure that all EVAL board jumpers are well configured. For more details, refer to Section 1.10.11: STM32L152D-EVAL board jumper configuration.

This demonstration firmware and other such firmware are available for download from the STMicroelectronics website: *www.st.com*.

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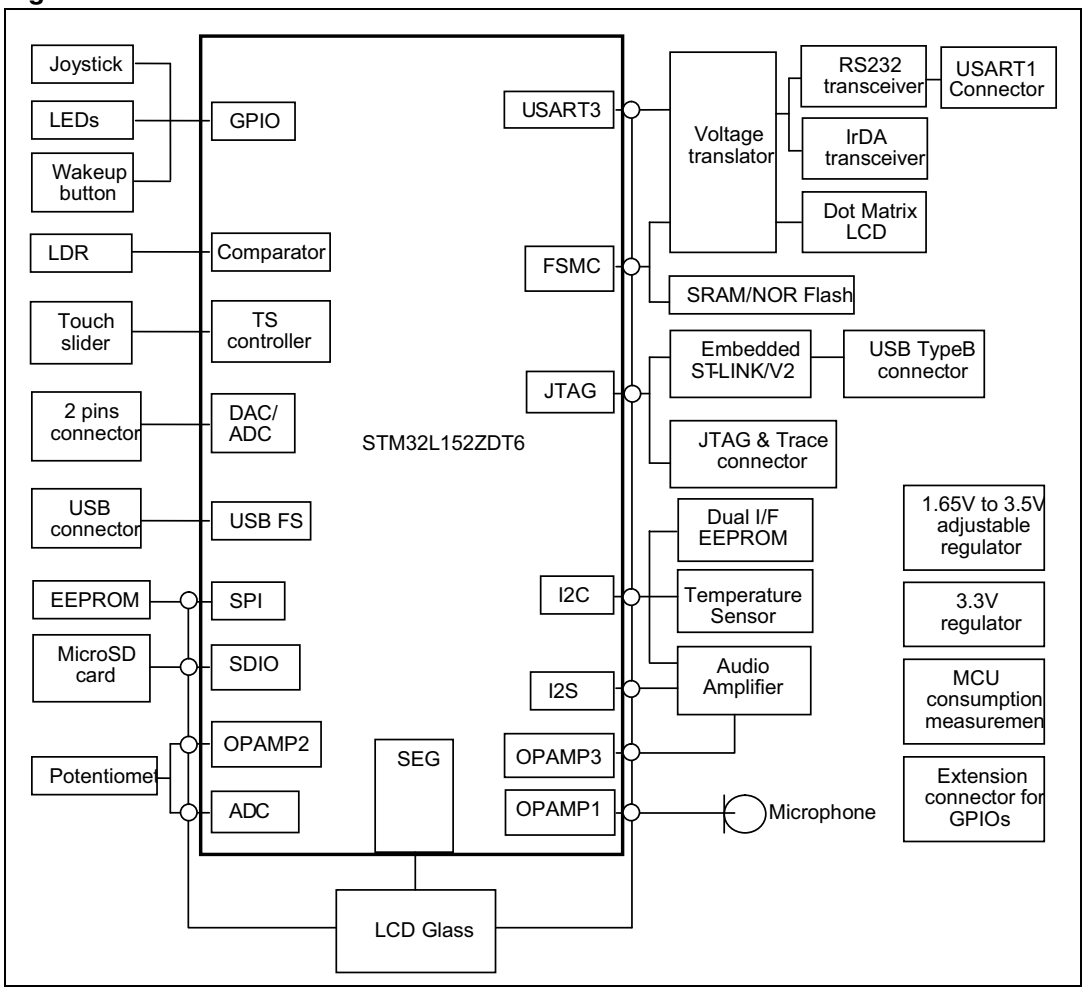
1 Functional description

The STM32L152ZD(T6) microcontroller evaluation board provides a development and demonstration platform for STM32L152D-based applications. It is designed to allow the user to try out the major functions of the STM32L152ZD(T6) microcontroller.

Figure 1 summarizes the main functional blocks of the evaluation board.

Figure 1. Evaluation board overview



1.1 Power control

The evaluation board can be powered from an external 5 V supply or from the USB connector or ST-Link connector. All other required voltages are provided by on-board voltage regulators.

1.2 Clocking

Two clock sources are available on the STM32L152D-EVAL evaluation board:

- 32 kHz crystal for embedded RTC and glass LCD
- 8 MHz crystal for the STM32L152ZD main clock system

1.3 Reset control

The reset can be generated by hardware or software:

- Reset button: activates the RESET input when pressed
- JTAG reset

1.4 Debug JTAG interface

Software debug is done via the standard ARM® JTAG connection: 20-pin IDC (insulation displacement connector) for connection to the standard ARM host interface.

1.5 Serial wire debugger interface

The Serial Wire Debug Port (SWD-DP) provides a 2-pin (clock + data) interface to the AHP-AP port.

1.6 Embedded ST-LINK

An embedded ST-LINK is integrated on the board as an embedded in-circuit debugger and programmer for the STM32L152ZD MCU.

1.7 Display devices

1.7.1 LCD

A color LCD module is mounted on the STM32L152D-EVAL board. It is interfaced through the embedded FSMC peripheral.

1.7.2 LCD Glass

An LCD Glass module is mounted on the STM32L152D-EVAL board. It is interfaced through the embedded LCD Glass peripheral.

1.7.3 LEDs

Four general-purpose LEDs are available. They are used as a display.

1.8 Interfaces

1.8.1 RS232

The STM32L152 evaluation board (STM32L152D-EVAL) provides one on-board RS-232 serial port. RS232 port (USART1) is accessed via CN1 connectors.

1.9 IrDA

The STM32L152D-EVAL evaluation board supports IrDA communication. The interface is mounted on USART1.

1.10 Miscellaneous peripherals

1.10.1 Joystick

Four-direction joystick with a selection key.

1.10.2 Push-buttons

The STM32L152D evaluation board (STM32L152D-EVAL) provides only one push-button (key). This key can be used as a user push-button, a tamper push-button or a wakeup push-button (to wake-up the processor from a low-power mode).

1.10.3 12-bit analog-to-digital converter (ADC)

Varistor: ADC channel (ADC1_IN18) connected to an on-board variable resistor. The variable resistor provides a voltage in the range of 0 V to 3.3 V.

1.10.4 Audio

The STM32L152D-EVAL evaluation board supports stereo audio play thanks to an audio DAC CS43L22 connected to both I2S2 ports, and one channel of DAC in microcontroller STM32L152ZD.

For the audio output, an audio jack is available on the board and connected to the CS43L22 output.

The U3 microphone is connected to ADC internal through OPAMP1.

1.10.5 MicroSD card

The STM32L152D-EVAL evaluation board has a MicroSD card connector connected to the SDIO peripheral.

1.10.6 Serial EEPROM

The STM32L152D-EVAL evaluation board includes a serial EEPROM connected to the SPI1 peripheral.

1.10.7 M24LR64 dual Interface EEPROM (RF/I²C)

The M24LR64 dual Interface EEPROM daughter board implemented on the module is the M24LR64-R. The daughter board can be connected on CN12 to STM32L152ZDT6 via I2C bus.

I²C device Select of the M24LR64 is 1010 E2E1E0. For more details about the M24LR64 memory addressing in I²C mode, please refer to the M24LR64 datasheet.

1.10.8 SRAM

The STM32L152D-EVAL evaluation board includes a 512Kx16 SRAM connected to bank2 of FSMC interface.

1.10.9 NOR Flash

The STM32L152D-EVAL evaluation board provides a 128-Mbit of Nor Flash connected to bank1 of FSMC interface.

1.10.10 Temperature sensor

The STM32L152D-EVAL evaluation board includes an I^2C temperature sensor connected to the I2C1 peripheral.

1.10.11 STM32L152D-EVAL board jumper configuration

To be able to run the STM32L152D-EVAL demo correctly, configure the following STM32L152D-EVAL board jumpers as follows:

- JP1: fitted in PSU position
- JP2: fitted in LDR position
- JP4: fitted in RS232 position
- JP5: fitted in VDD position <->3.3 V
- JP6, JP8: fitted in position 1<->2
- JP7: fitted in position 1<->2
- JP10: fitted in IDD position
- JP14 I2C_SMB: fitted
- The LCD Glass should be in IO position.

2 Running the demonstration

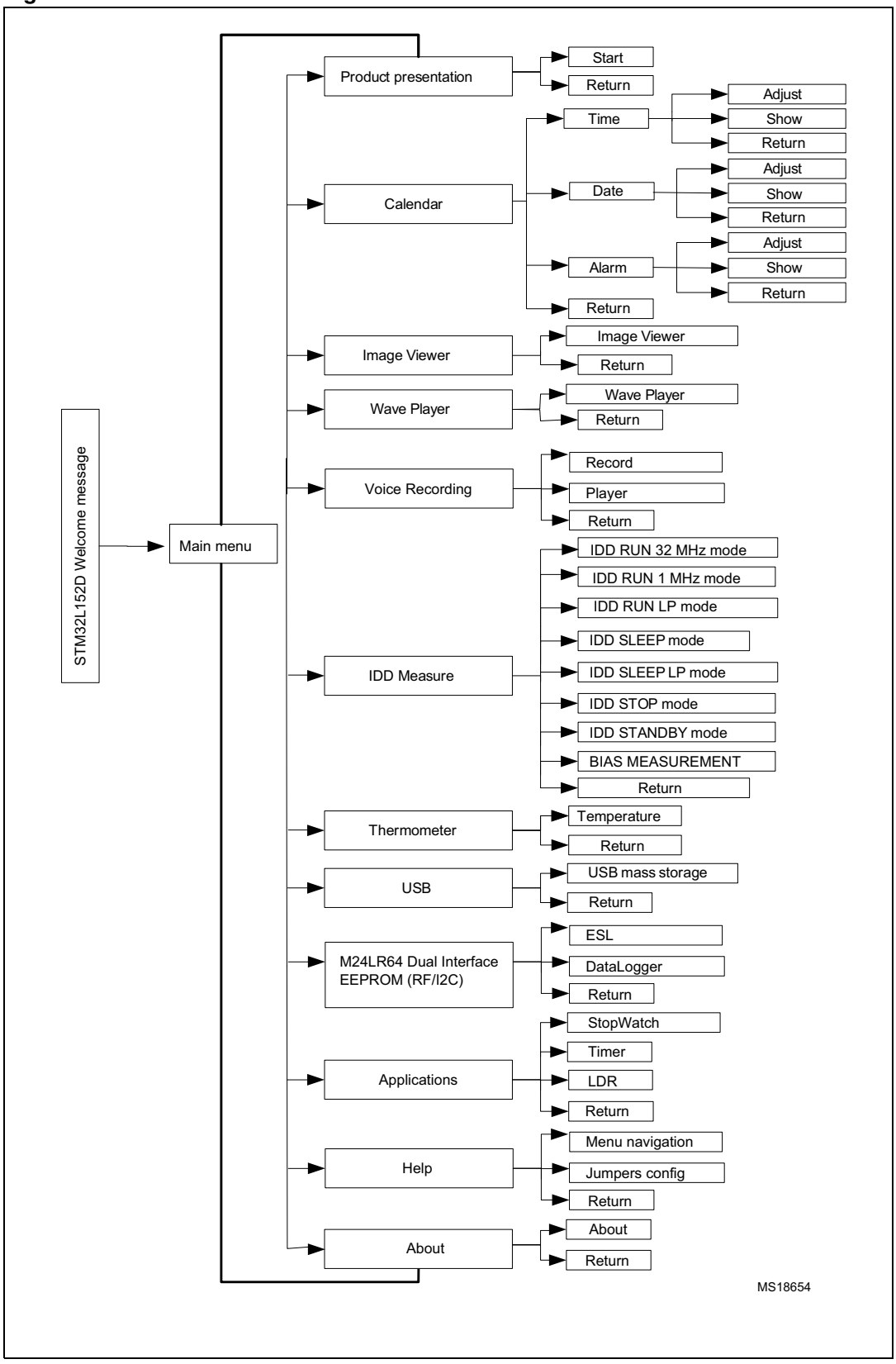
2.1 Menu

Figure 2 shows the menu system of the STM32L152D demonstration. The main menu is shown on the left-hand side. The UP, DOWN, RIGHT and LEFT joystick directions allow the user to navigate between items in the main menu and the submenus. To enter a submenu, press the SEL push-button.

The SEL push-button designates the action of vertically pressing the top of the joystick, as opposed to moving it horizontally UP, DOWN, RIGHT or LEFT.

To exit a submenu, select the Return menu and press SEL.

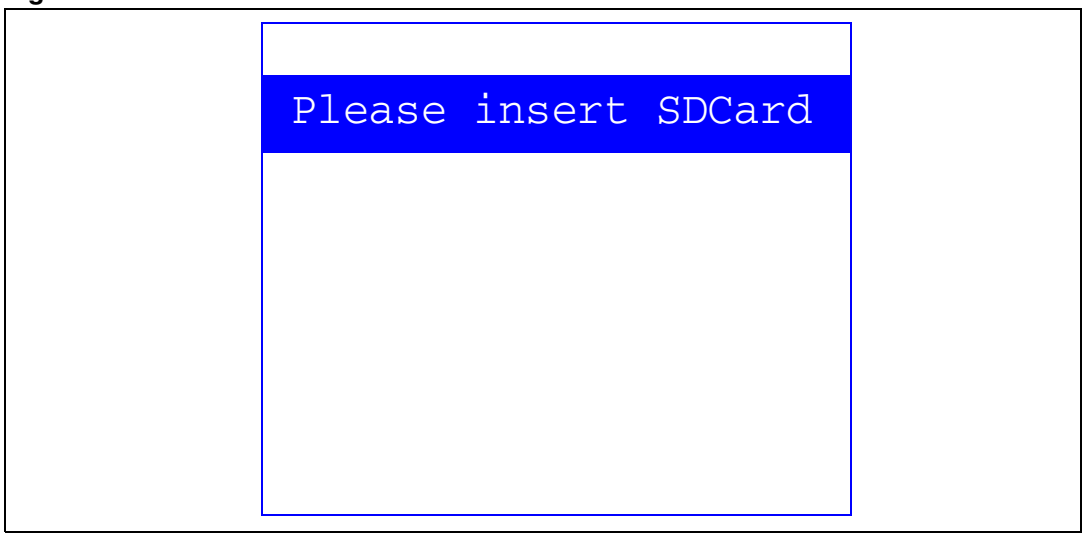
Figure 2. Structure of the demonstration menus



2.1.1 Demo startup

After a board reset, at demo startup, the system checks if an SD card memory is already present in connector CN3. If no card is detected, the demo does not start and the message shown in *Figure 3.* is displayed on the LCD screen.

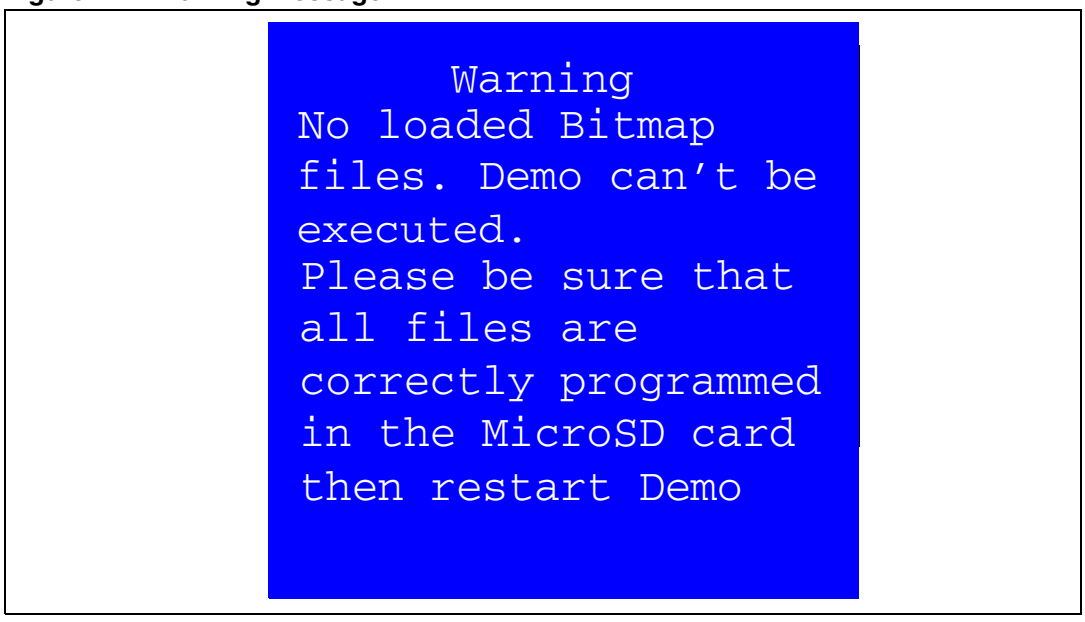
Figure 3. SD card check



The demo continues only if an SD card is inserted.

Then, the demo graphic icons and bitmap files are checked in the MicroSD card (see *Section 2.3.5: External memory organization*). All the icons have to be correctly programmed in the MicroSD card for the demo to start, so if an icon is missing, the demo does not start and the message shown in *Figure 4* is displayed on the LCD screen.

Figure 4. Warning message



However, if the icons are correctly loaded into the SD Card memory, the welcome screen is displayed and the ST logo appears on the LCD (see *Figure 5*).

Figure 5. ST logo

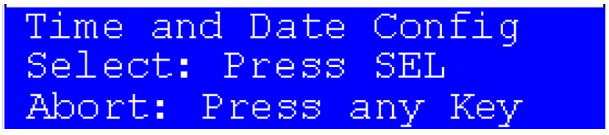
Then, after 1 second, an STM32 presentation slide is displayed on the LCD screen.

Figure 6. STM32L presentation slide

When the board is powered-up for the first time, the user is prompted to set the time, year, month and day. The user may choose to ignore it by pressing any key except for the SEL push-button to abort the configuration sequence. To set the time and date, the user must press SEL and follow the setting sequence.

The message shown in *Figure 7* appears on the LCD screen.

Figure 7. Time and date configuration



Note: 1 If the user chooses to configure the time and date, the Time Adjust and Date Adjust menus are displayed. Otherwise, the main menu is displayed and the user can set the time parameters in the Calendar menu. To set the time/date, use the joystick UP/DOWN and SEL push-buttons.

2 If the time configuration has already been done, then the number of elapsed days (higher than 1 day), from the last time the demo board was powered-up, appears on the LCD screen. It is soon followed by the current date.

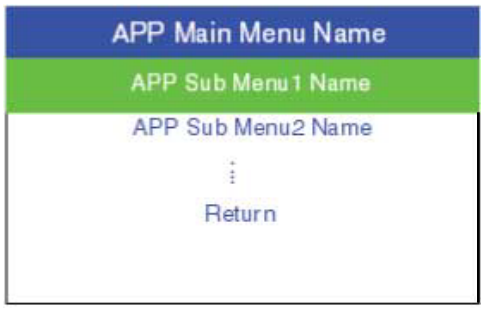
Once the time/date have been set, the main menu appears. The main menu is displayed in the form of a set of icons. It shows all the submenus in the same screen. You can navigate using the UP, DOWN, RIGHT and LEFT joystick directions to select the required submenu. To enter a submenu, press the SEL joystick push-button, and the new submenu corresponding to the selected icon is displayed.

Figure 8. Main menu

Note: The icons shown in Figure 8 are taken from http://commons.wikimedia.org/wiki/Crystal_Clear.

Once a submenu has been selected, the name of the application is listed at the top of the display and all the corresponding submenus are listed below, as shown in *Figure 9*.

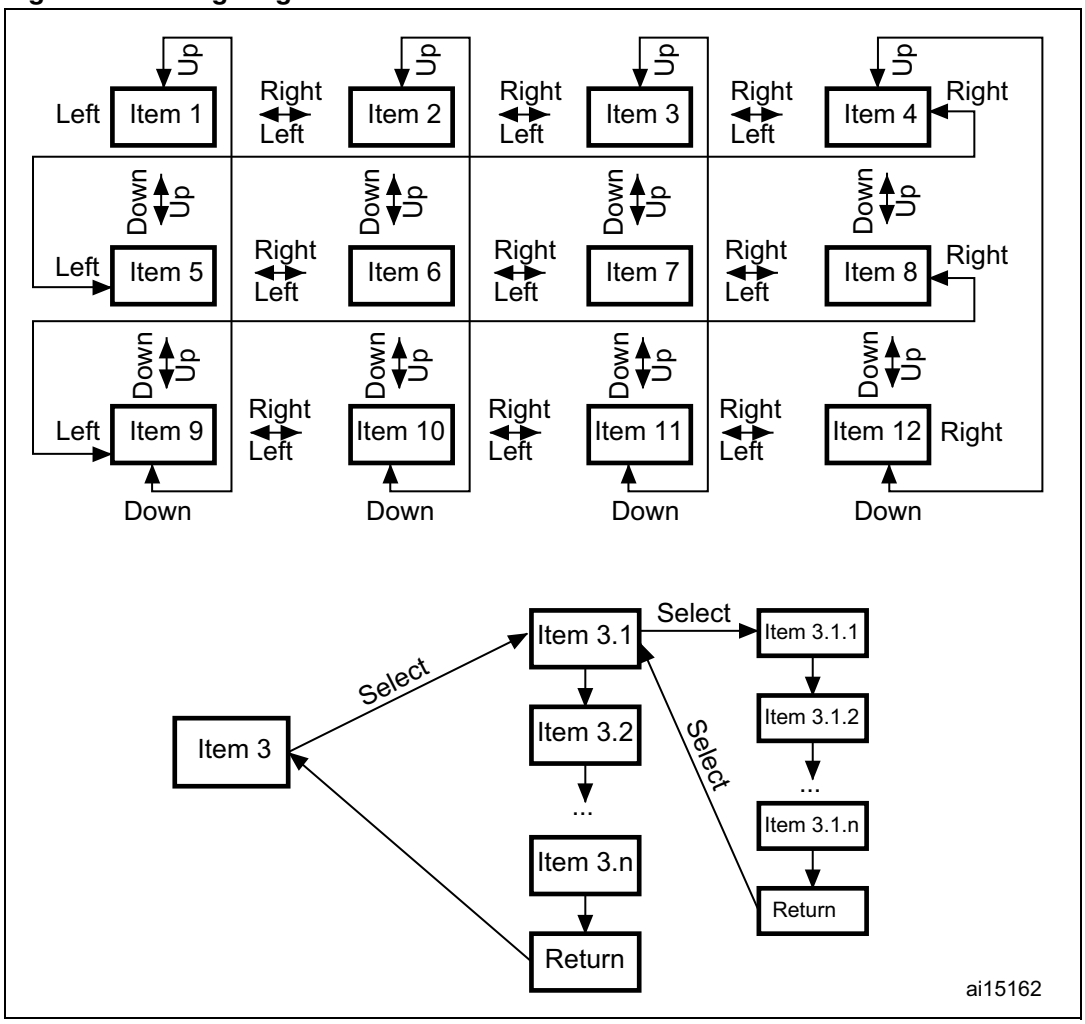
Figure 9. Corresponding submenus



2.1.2 Navigation

The demonstration menu is based on circular navigation, submenu selection, item selection and back navigation, as described in *Figure 10*.

Figure 10. Navigating in the demonstration menus



The user navigates using the joystick push-buttons located on the evaluation board: RIGHT, LEFT, SEL, UP and DOWN.

- The UP, DOWN, RIGHT and LEFT push-buttons are used to perform circular navigation in the main menu and the current menu items.
- The SEL push-button selects the current item.
- The UP and DOWN push-buttons are used for vertical navigation in the submenus.
- To return to the upper menu, go to the Return line and press SEL.

2.2 Clock sources

2.2.1 Clock control

The STM32L152ZD's internal clocks are derived from the HSE (clocked by the external 8 MHz crystal).

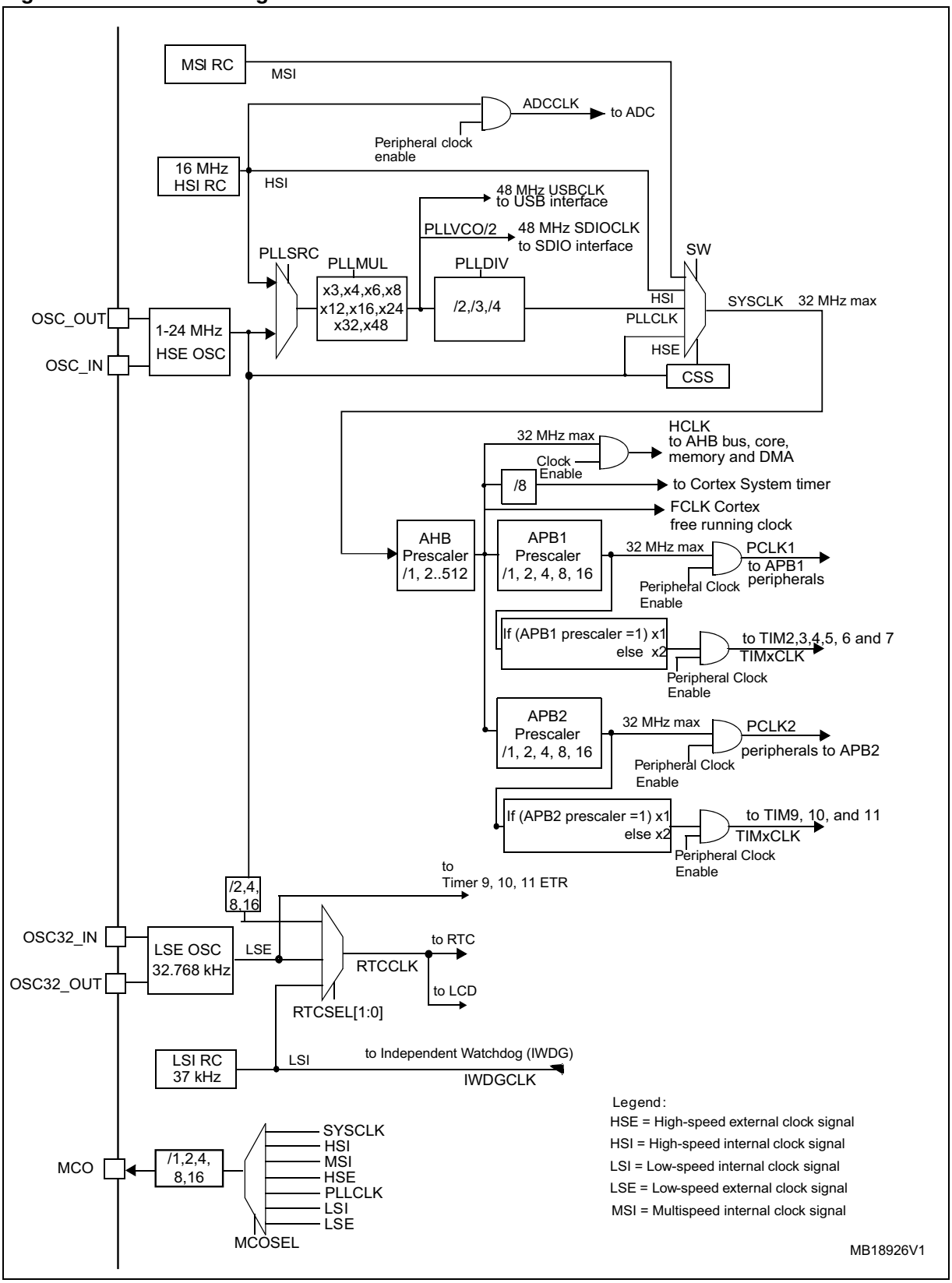
In this demo application, the various system clocks are configured as follows:

- System clock is set to 32 MHz: the PLL is used as the system clock source: 32 MHz (1 wait state, Flash memory prefetch buffer enabled).
- HCLK frequency is set to 32 MHz.
- Timer clock (TIMCLK) is set to 32 MHz.
- USB clock is set to 48 MHz.
- ADC clock is set to 16 MHz.
- PCLK1 is set to 32 MHz.
- PCLK2 is set to 32 MHz.

Only the RTC is clocked by a 32 kHz external oscillator.

Figure 11 illustrates the clock tree organization for this demo.

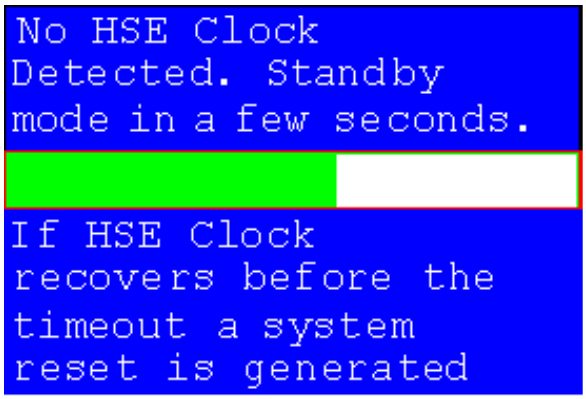
Figure 11. Clock tree diagram



2.2.2 Clock failure

At any demo level, if no clock is present on OSC_IN (broken or disconnected crystal), the message shown in *Figure 12* is displayed on the LCD screen.

Figure 12. No HSE clock detected

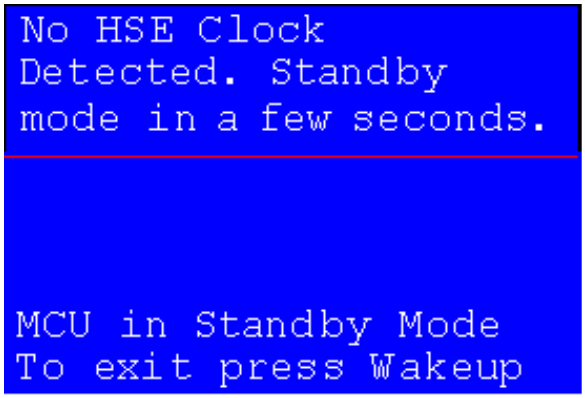


If the 8 MHz crystal is not reconnected in the next few seconds, the MCU enters Standby mode. If the 8 MHz crystal is reconnected within a few seconds, a system reset is generated.

Note: The clock security system (CSS) feeds the MCU with the MSI OSC used as an emergency clock, if no clock is detected.

When a timeout occurs, the MCU enters Standby mode and the message shown in *Figure 13* is displayed on the LCD screen.

Figure 13. Standby mode entered



Note: The demo does not restart as long as the 8 MHz crystal is not present.

Connecting the 8 MHz crystal after reset may not restart the demo correctly. The crystal must be connected before starting the demo.

2.3 STM32L152ZD(T6) resources

2.3.1 Peripherals

All used peripherals are described in *Table 1*.

Table 1. STM32L152ZD(T6) demo peripherals

Used peripherals	Application
I2C1	Temperature sensor, dual interface EEPROM (RF/I²C)
I2S2	Audio playback, product presentation
EXTI	Menu navigation + joystick + push-button + IDD measure + audio + Applications
GPIO	All applications + LEDs
NVIC	All applications using interrupts
PWR	IDD measure
RCC	All applications + Demo kernel
RTC	Calendar + Applications (StopWatch and Timer)
FSMC	Color LCD
SysTick	Generate 10 ms time base
TIM2	LED toggling
SDIO	MicroSD
TIM3 and TIM4	Voice recording
ADC1	Voice recording + IDD measure
SPI1	SPI Flash
DAC	LDR (define the comparator level)
USB	USB mass storage
OPAMP3	Low pass filter for the Audio demo
COMP	LDR (Brightness level)

2.3.2 Interrupts

Table 2 shows all the enabled interrupts.

Table 2. STM32L152ZD demo interrupts

Interrupts	Priority	Used for
SysTick	Preemption: 0 SubPriority: 0	System timing
PVD	Preemption: 0 SubPriority: 0	Adapt the System Clock to voltage range
RTC Wake-Up	Preemption: 1 SubPriority: 1	Calendar, date update

Table 2. STM32L152ZD demo interrupts (continued)

Interrupts	Priority	Used for
NMI	Preemption(fixed): -2	CSS interrupt
EXTI0	Preemption: 0 SubPriority: 0	Wake-Up button
EXTI9_5	Preemption: 3 SubPriority: 2	Menu navigation
EXTI15_10	Preemption: 2 SubPriority: 2	Menu navigation
I2C1 Error	Preemption: 0 SubPriority: 0	SMBus Alert interrupt
TIM4_UP	Preemption: 1 SubPriority: 0	Enable SDIO write operation
TIM3_UP	Preemption: 0 SubPriority: 1	Sampling rate
TIM2_UP	Preemption: 1 SubPriority: 1	LED toggling
RTC Tamper	Preemption: 1 SubPriority: 1	Tamper generation
RTCAlarm	Preemption: 1 SubPriority: 1	Alarm generation
COMP	Preemption: 2 SubPriority: 1	LCD Glass contrast adjust
SDIO	Preemption: 0 SubPriority: 0	Writing in the SDIO
DMA1	Preemption: 0 SubPriority: 0	DMA1 transfer comp
SPI2	Preemption: 0 SubPriority: 0	I2S interrupt
USB	Preemption: 0 SubPriority: 0	USB sub-Demo

2.3.3 External interrupts

Table 3. STM32L152ZD demo external interrupts

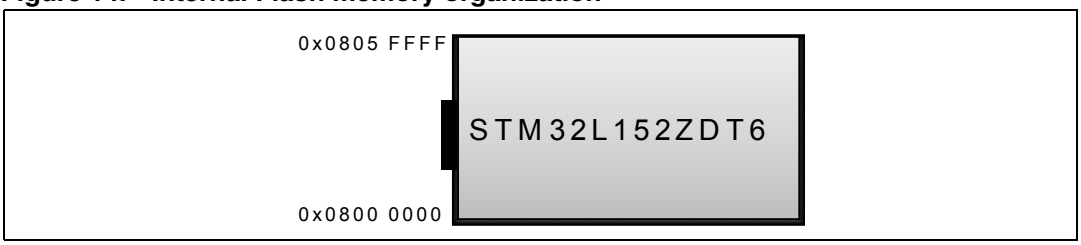
External interrupts	Used for
EXTI line 13	Joystick SEL (interrupt mode, falling edge)
EXTI line 11	Joystick UP (interrupt mode, falling edge)
EXTI line 6	Joystick LEFT (interrupt mode, falling edge)
EXTI line 7	Joystick RIGHT (interrupt mode, falling edge)
EXTI line 8	Joystick DOWN (interrupt mode, falling edge)
EXTI line 0	User Button (interrupt mode, falling edge)

Table 3. STM32L152ZD demo external interrupts (continued)

External interrupts	Used for
EXTI line 17	RTC Alarm (interrupt mode, rising edge)
EXTI line 20	RTC wake up (interrupt mode, rising edge)
EXTI line 22	Comparator (interrupt mode, rising and falling edge)

2.3.4 Internal memory size

Figure 14. Internal Flash memory organization



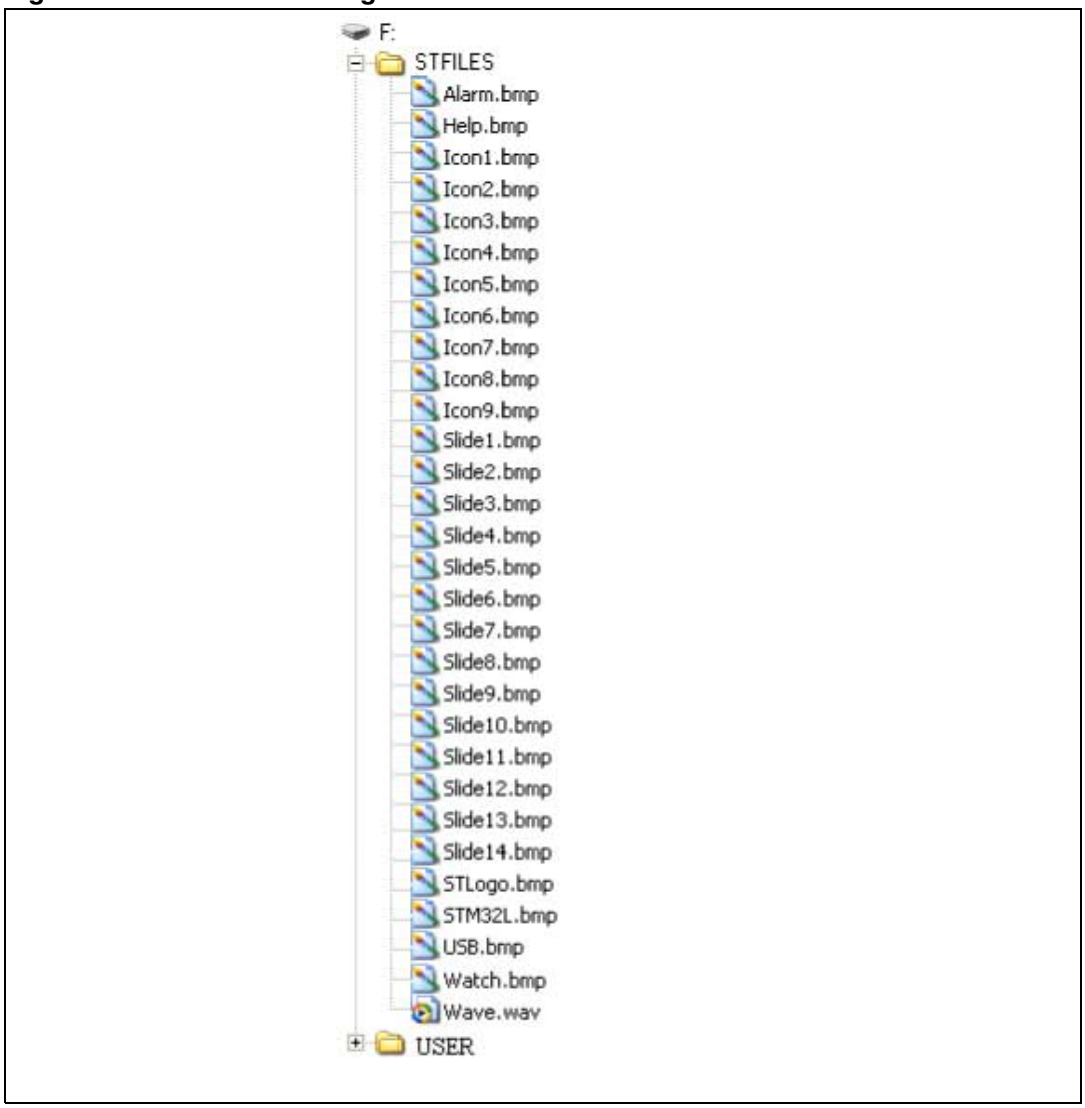
2.3.5 External memory organization

The STM32L152D-EVAL demo is based on an embedded free FAT file system, FatFs. The file system is needed to read all media information from the on-board MicroSD card memory. The SD card memory is organized in three subdirectories:

- STFILES: this directory contains all the required demo media files (icons, waves and slides). User files located in this folder cannot be handled by demo; only default files are managed.
- USER: this is a user folder. The user can add his/her own files here to be played inside the demo menus (pictures and waves). This folder is used only by the Image Viewer and Wave Player submenus. For more details on the various files properties, please refer to *Section 2.4.3: Image Viewer submenu* and *Section 2.4.4: Wave Player submenu*.
- REC: this directory contains the voice recorded wave file “Rec_wave.wav“.(This Folder will be created when the Voice Recording application is run).

Note: The STFILES directory and its internal files are mandatory for demo startup. FatFs is a generic FAT file system module for small embedded systems. The FatFs is written in compliance with ANSI C and completely separated from the disk I/O layer. For more details, refer to the following link: http://elm-chan.org/fsw/ff/00index_e.htmltml.

Figure 15. MicroSD card organization



Note: The user can add his/her 16-bit bitmap images (320x240) and wave files in the USER folder.

At any demo level, if the SD card is removed, the demo stops and the message shown in Figure 16 is displayed on the LCD screen.

Figure 16. SD card removal

2.4 Demo applications

The following section provides a detailed description of each part of the demonstration.

Note: In the demonstration, the core runs at HCLK = 32 MHz.

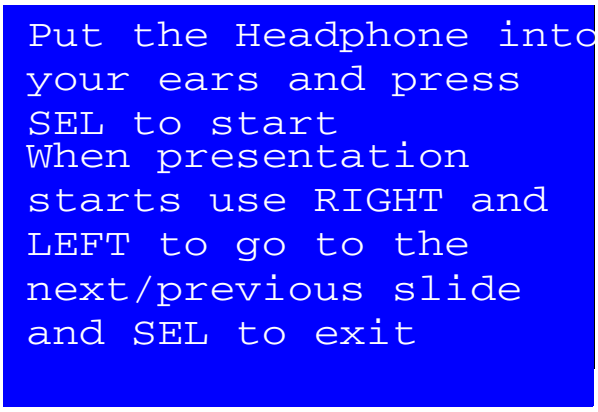
Four LEDs (LD1, LD2, LD3 and LD4) flash throughout the demonstration at a frequency depending on the core clock.

2.4.1 Product presentation

This part of the demo is dedicated to the listing of all the embedded STM32L152ZD(T6) peripherals and features. This presentation of the microcontroller is made with a set of slides accompanied by a speech. Each slide is associated with a dedicated speech (wave file). When the user starts the product presentation, the first slide appears and the corresponding speech starts. Once the speech is finished, the second slide is displayed accompanied by its speech, and so on until the last slide.

When the Product presentation menu is selected, the message shown in *Figure 17* is displayed on the LCD screen.

Figure 17. Product presentation is ready to start



Product presentation slides

The set of slides is composed of 14 slides listing all features and advantages of the STM32L152ZD(T6). *Figure 18* and *Figure 19* show the first and last slides, respectively.

Figure 18. First presentation slide

Figure 19. Last presentation slide

Product presentation speech

The STM32L152ZD microcontroller has an embedded I2S2 peripheral that can be used for audio communication.

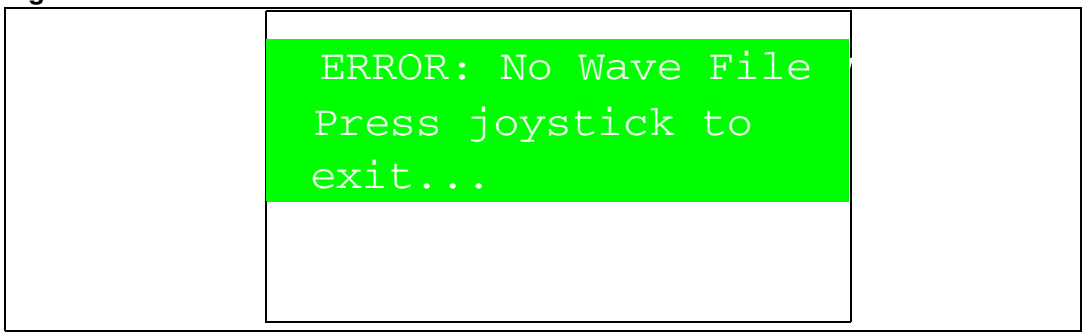
An external audio codec CS43L22 is implemented on the evaluation board in order to allow speech audio files to be played through the embedded headphone.

The properties of the product presentation speech wave files are the following:

- Playing time: 6 min 16 s
- File number: 14 wave files
- File names: WAVE_Si (i designed the slide index)
- Format tag: PCM
- Channels: Stereo
- Sample rate: 8 kHz
- Bits per sample: 16 bits

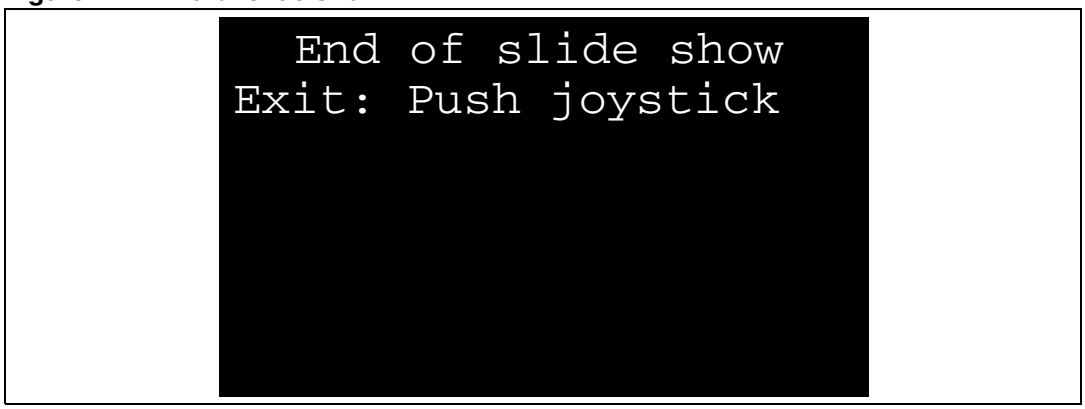
Note: If any wave files of the promotion presentation speech is not loaded in the dedicated memory, the message shown in Figure 20 is displayed on the LCD screen.

Figure 20. No loaded wave file



To stop the product presentation slide show and speech, push the SEL push-button. The message shown in *Figure 21* is displayed.

Figure 21. End of slide show



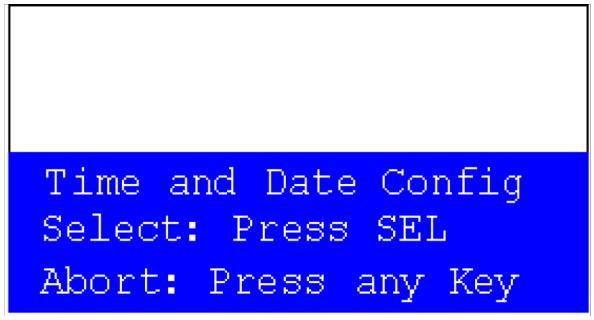
At the end of the product presentation, or if the presentation was stopped, simply press any joystick key to exit and return to the Product presentation submenu.

2.4.2 Calendar

The STM32L1xx features a real-time clock (RTC) which is an independent BCD timer/counter. The RTC provides a time-of-day clock/calendar, two programmable alarm interrupts, and a periodic programmable wakeup flag with interrupt capability.

This submenu is used to configure the time, date and alarm. In any submenu, if the time and date parameters have not yet been configured, the message shown in *Figure 22* is displayed on the LCD screen.

Figure 22. Setting the time and date



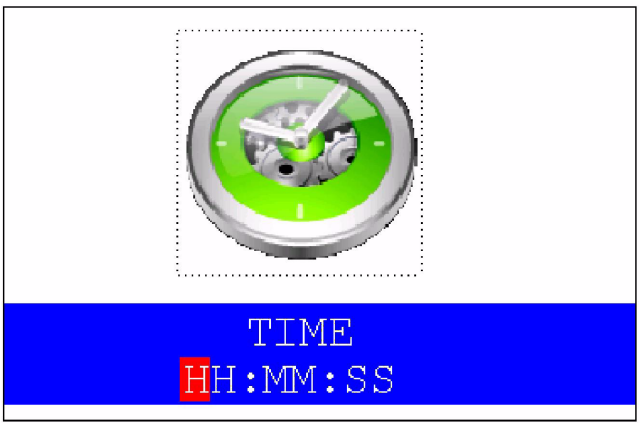
The user can choose to set or not the time, year, month and day. Press any key (except for SEL) to ignore the prompt and abort the configuration sequence. Press SEL and follow the setting sequence to set the time and date.

Time submenu

This submenu is divided into two items that allow the user to display or set the current time.

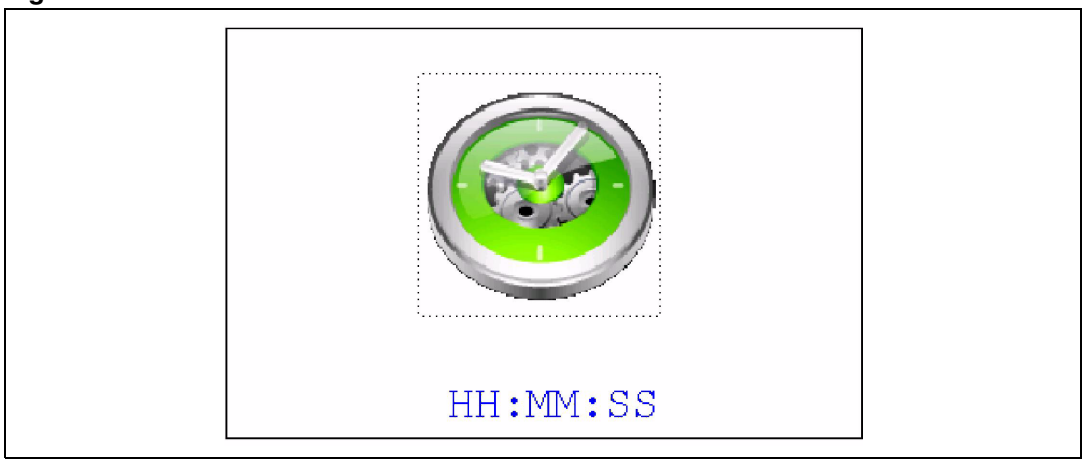
- **Time Adjust:** after the evaluation board is powered-up, select this submenu to change the default time (00:00:00) to the current time. Once Time Adjust has been selected, the first digit of the hour field can be changed. Press the UP button to display the current value plus one. Press the DOWN button to display the previous digit value. After setting the digit value, press SEL, and the cursor automatically jumps to the next digit. When all the time digits have been set, the Time submenu appears. Some digit values are limited to a range of values depending on the field (hour, minutes or seconds). The following message (with the default time or the current time) is displayed on the LCD when this submenu is selected.

Figure 23. Time Adjust submenu



- **Time Show:** this item displays the current time. If time and date have not been configured before, a message is displayed, prompting the user to set the time and date or to exit to the upper submenu. When this submenu is selected, the message shown in *Figure 24* appears on the LCD. In the example, the time has not been set yet.

Figure 24. Time Show submenu



To exit the Time Show submenu, press the SEL push-button. To exit the Time submenu, select the Return line and press the SEL push-button.

Date submenu

This submenu is divided into two items that allow the user to display or set the current date.

- **Date Adjust:** select this item after each power-up in order to set the current date. If the time and date have not been configured before, a message is displayed, prompting the user to set the time and date or to exit to the upper submenu.

  The user is requested to set the current date to be stored in the application memory. The date is displayed as Year, Month, Week Nbr, Day Nbr (number of the day in the year) with the selected day shown in the month. There is no default date since the user has to set the date at least once.

  Once the submenu has been selected, the user starts by setting the year, then the month and the day of the selected month. The month and the year are selected using the UP or DOWN push-button. For the day, the UP, DOWN, RIGHT and LEFT push-buttons can be used. Press the UP push-button to display the current value plus one; press the DOWN push-button to display the previous value. To confirm the selected month, press the SEL push-button. The display then jumps to the year configuration. The same procedure is applicable for the year configuration.

  After configuring the day, press the SEL push-button to store the entered value and exit to the Date submenu. The current date value is then shown and you can change the setting if required. The messages shown in *Figure 25*, *Figure 26* and *Figure 27* are successively displayed on the LCD when this submenu is selected.

Figure 25. Setting the year

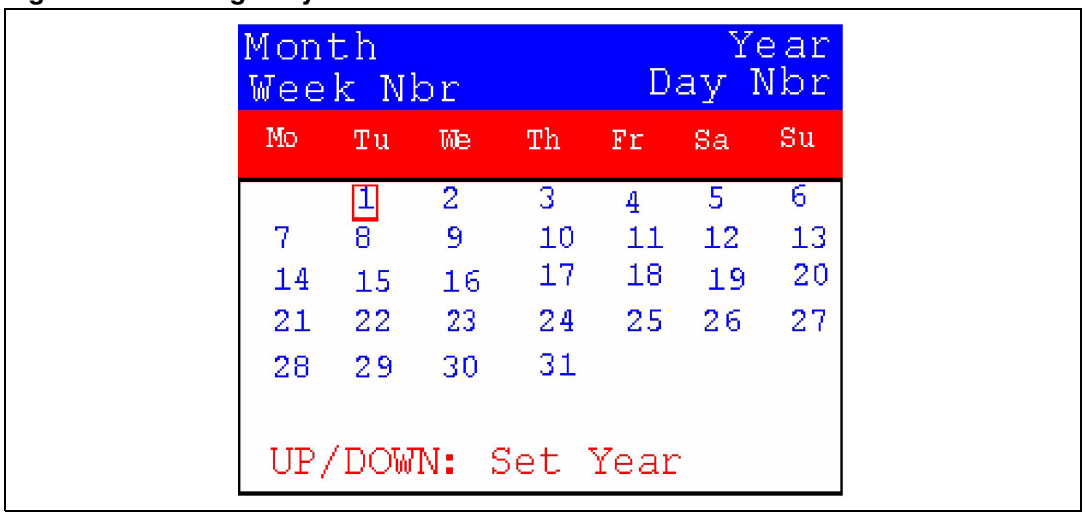


Figure 26. Setting the month

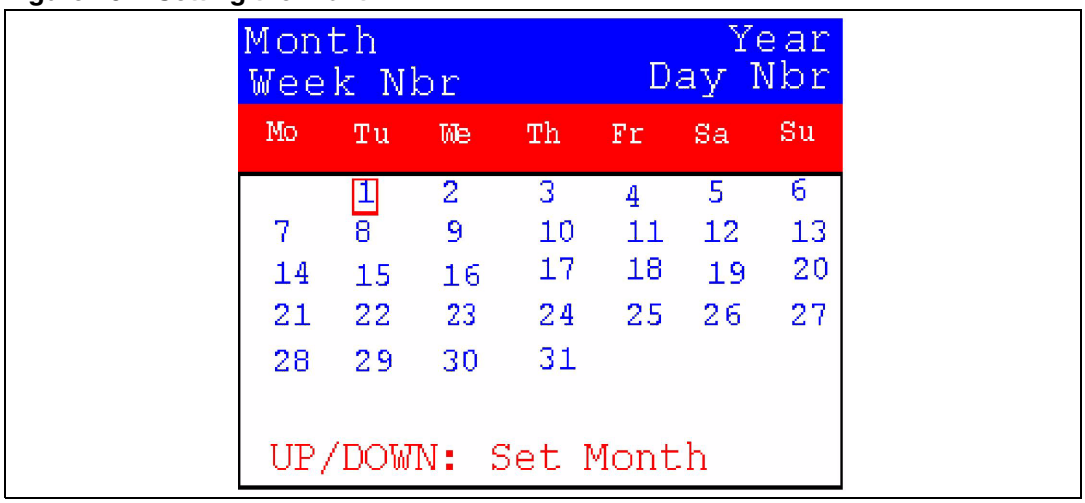
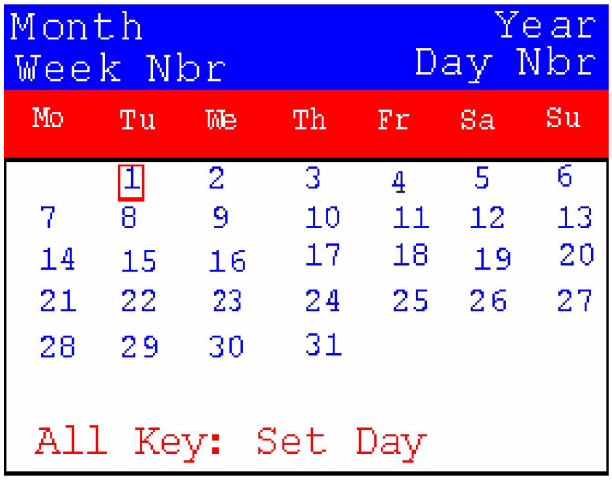


Figure 27. Setting the day of the month



- **Date Show:** this item displays the current date. If the time and date have not been configured before, a message is displayed, prompting the user to set the time and date or to exit to the upper submenu. The message shown in *Figure 28* is displayed on the LCD when the submenu is selected (with the date already configured).

Figure 28. Exiting the Date Show submenu

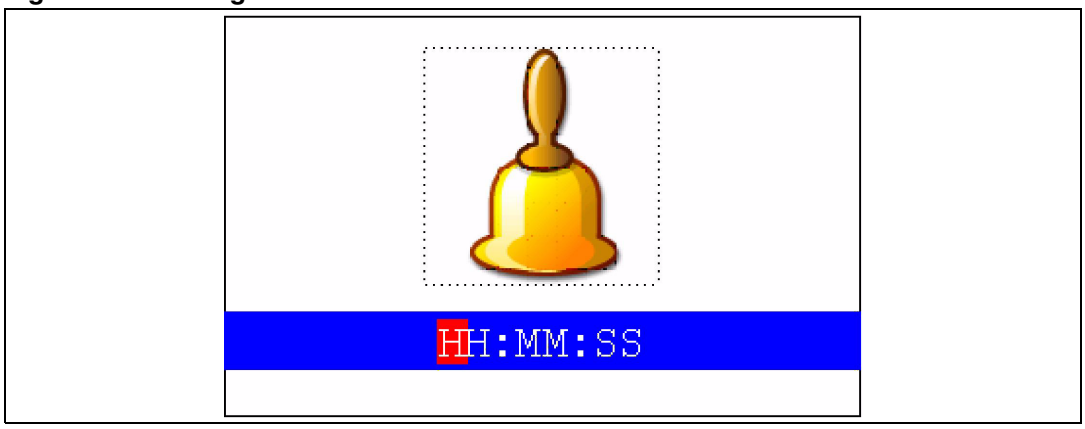
To exit this submenu, press the SEL push-button. To exit the Date submenu, select the Return line and press the SEL push-button.

Alarm submenu

Using this submenu, the user can configure the alarm activation time. When the alarm time value is reached, all the LEDs (LED1 to LED4) start flashing together for 30 seconds. This submenu is divided into two items that allow the user to display or set the current alarm.

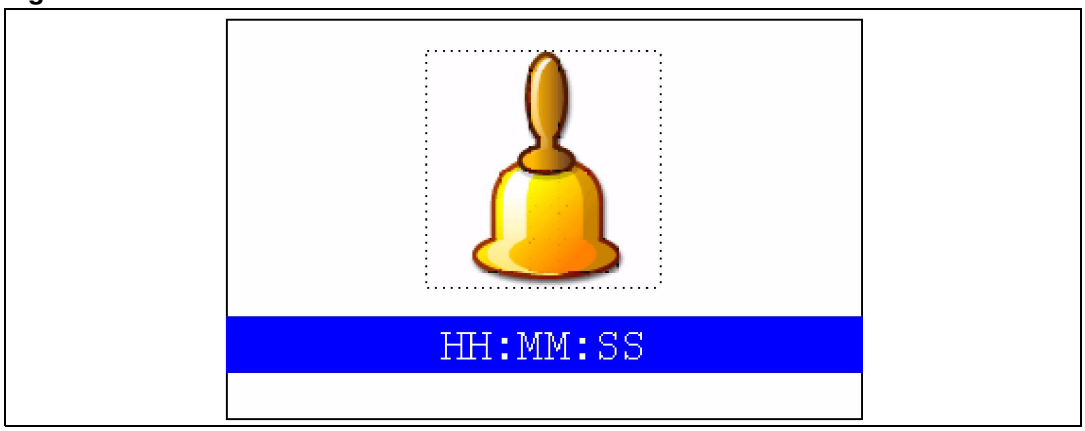
- **Alarm Adjust:** the alarm time activation is set in the same way as the time in the Time Adjust submenu. The following messages are successively displayed on the LCD when this submenu is selected:

Figure 29. Setting the alarm activation time



- **Alarm Show:** this item displays the current alarm time. The default Alarm activation time displayed after power-up and before setting in the Alarm Adjust submenu is 00:00:00. If the time and date have not been configured before, a message shown in *Figure 31* is displayed. Pressing SEL takes you back to the Alarm submenu. The message shown in *Figure 30* is displayed on the LCD when this submenu is selected.

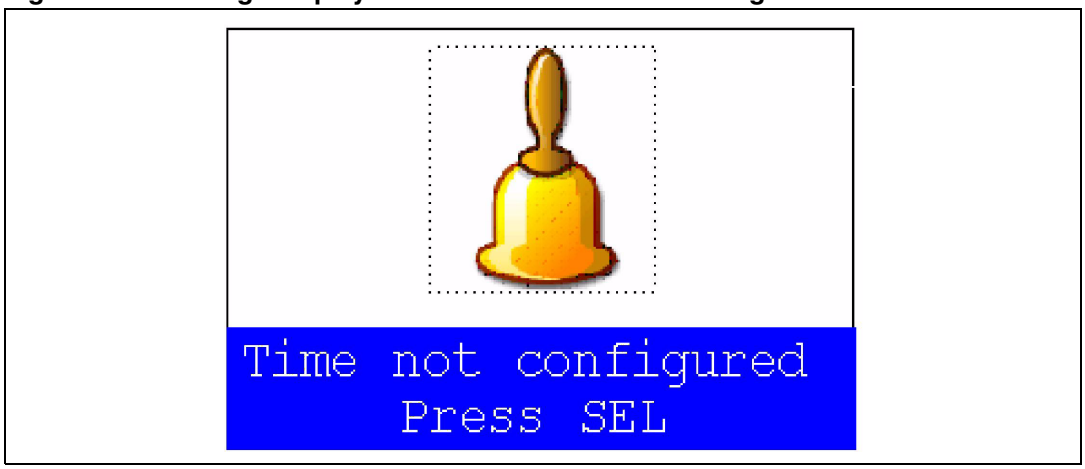
Figure 30. Alarm Show submenu



To exit the Alarm Show submenu, press the SEL push-button. To exit the Alarm submenu, select the Return line and press the SEL push-button.

Note: In the Alarm Adjust and Alarm Show menus, if the time and date have not yet been configured, the message shown in Figure 31 is displayed on the LCD screen.

Figure 31. Message displayed if time and date need setting



Note: When the Calendar is configured, the following messages are displayed respectively in an infinite loop on LCD Glass STM32L, Time and Date.

The LCD Glass contrast is adjusted according to the brightness detected using the LDR resistor connected to COMP2.

2.4.3 Image Viewer submenu

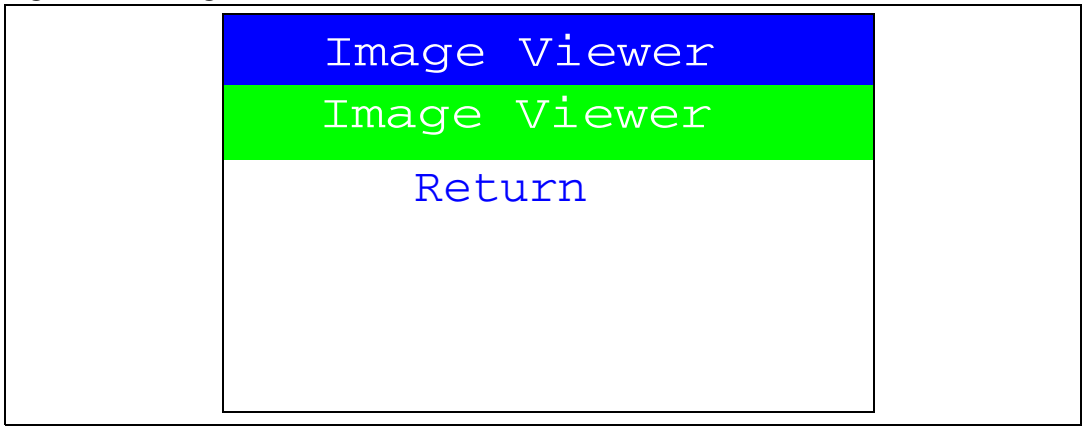
The Image Viewer submenu is used to demonstrate the LCD control performance using the embedded FSMC interface. The application is a successive display of stored images.

This application reads all bitmap pictures from the USER directory (see *Section 4.1: Programming the media files* and displays only the .BMP files having the following format:

- Bit depth: 16 bits (RGB)
- Size: 240x320

Select Image Viewer to display the submenu shown in *Figure 32*.

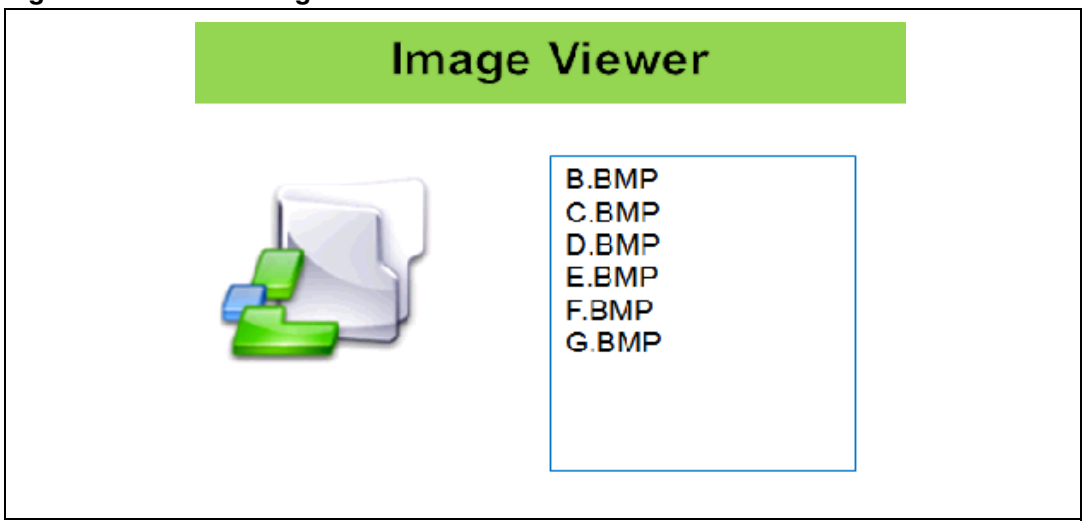
Figure 32. Image Viewer submenu



When Image Viewer is selected, a list box of images is displayed as shown in *Figure 33.*

Using the UP, DOWN and SEL push-button, the user can select and view any image from the listbox.

Figure 33. STM32 Image Viewer Listbox



When Image Viewer is selected, the corresponding image is displayed and then the user can use RIGHT and LEFT push-buttons to go to the next/previous image stored in the USER folder on the MicroSD card. If the DOWN push-button is pressed, the Image Viewer is stopped and the listbox shown in *Figure 33* is displayed.

If the LEFT or RIGHT push-button is pressed, the Image Viewer is stopped and the submenu shown in *Figure 32* is displayed.

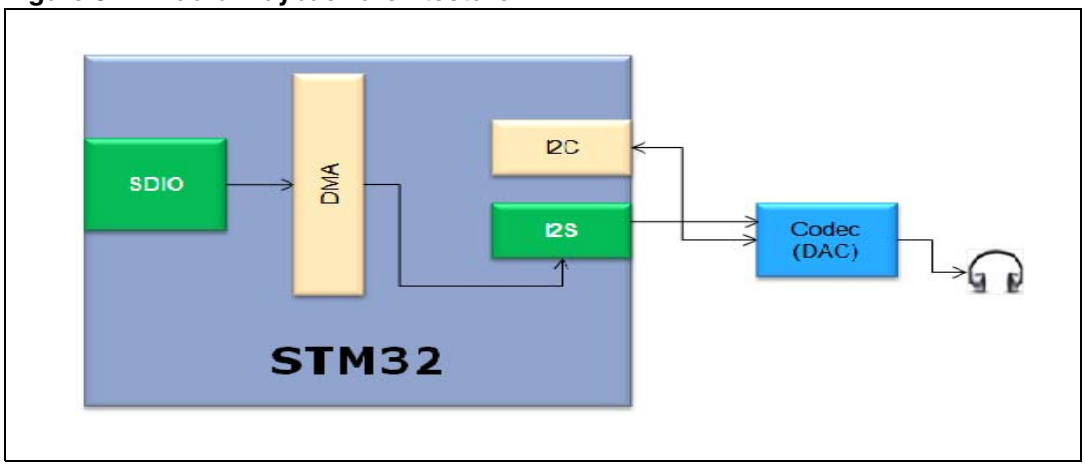
The supported image size is 240x320. The maximum number of images that can be read from the MicroSD card is 25 images, selected in alphabetic order.

2.4.4 Wave Player submenu

STM32L152D-EVAL evaluation board supports stereo audio play thanks to an audio Codec CS43L22 connected to I2S2 port and controlled by I2C1 interface.

In this demo, any wave file stored under the USER folder in the MicroSD card can be opened using the FatFs file system and transferred to the internal SRAM by block (512 bytes) using the DMA and the SDIO interfaces. All the wave files properties are read from the Wave File Header.

Figure 34. Audio Playback architecture



This application reads all wave files from the USER directory (see *Section 4.1: Programming the media files*) and plays only the .WAV files having the following format:

- Audio format: PCM (an uncompressed wave data format in which each value represents the amplitude of the signal at the time of sampling)
- Sample rate: Should be lower than 32,000 Hz.
- Bits per sample: 16 bits (audio sample data values are in the range [0-65535])
- Number of channels: 2 (stereo)

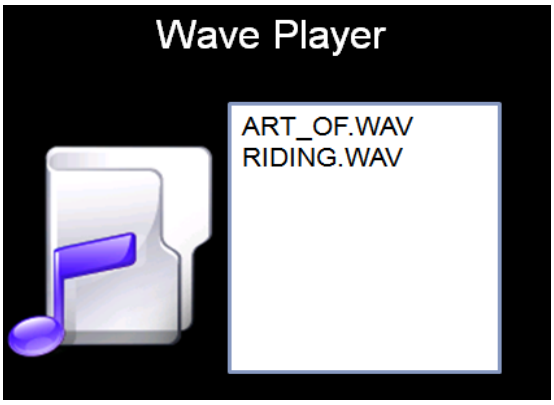
The maximum number of wave files that can be read from the MicroSD card is 25 files selected by alphabetic order.

Select Wave Player to display the submenu shown in *Figure 35*.

Figure 35. Wave Player submenu

When Wave Player is selected again, the wave player file names are displayed as a listbox, as shown in *Figure 36*.

Figure 36. Wave Player interface



Using UP, DOWN and SEL push-buttons, the user can select the desired wave file to be played.

Once the play command is activated, the submenu shown in *Figure 37* is displayed.

Figure 37. Wave Player Now Playing submenu

The progress bar and the volume value are displayed at the bottom of the Wave Player Now Playing submenu. The progress bar is updated every ~1% of the audio file duration, and the volume value is updated each time the volume level is changed.

At this application level:

- Press the SEL push-button to pause/play the audio stream.
- Press the LEFT push-button to stop the audio stream.
- Press the RIGHT push-button to exit the audio stream.
- Press the DOWN push-button to decrease the volume level.
- Press the UP push-button to increase the volume level.

When the audio stream is finished or the RIGHT push-button is pressed, the menu in *Figure 36* is displayed.

If the RIGHT push-button is pressed, the Wave Player is stopped and the submenu shown in *Figure 35* is displayed.

Note: The audio files provided within this package are based on a free music download from www.DanoSongs.com website.

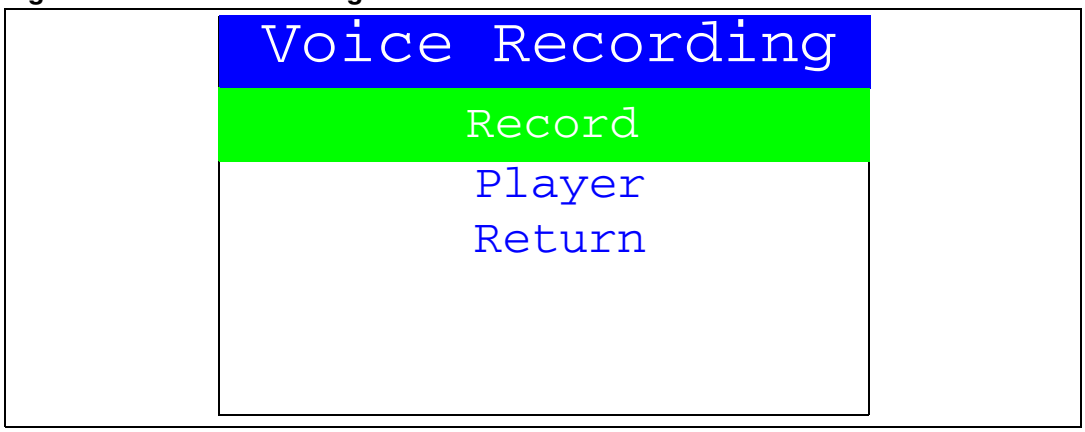
2.4.5 Voice Recording

The STM32L152ZD(T6) microcontroller has an embedded ADC and an embedded OPAMP1 which can be used to record a voice (signal coming from the U3 microphone). The OPAMP1 acts as a low pass filter.

In this demo, the recorded wave buffers can be transferred from the internal SRAM by block (512 bytes) and stored under the REC folder in the MicroSD card using the FatFs file system and based on DMA and SDIO. Timer3(TIM3) triggers the ADC to generate the sampling frequency.

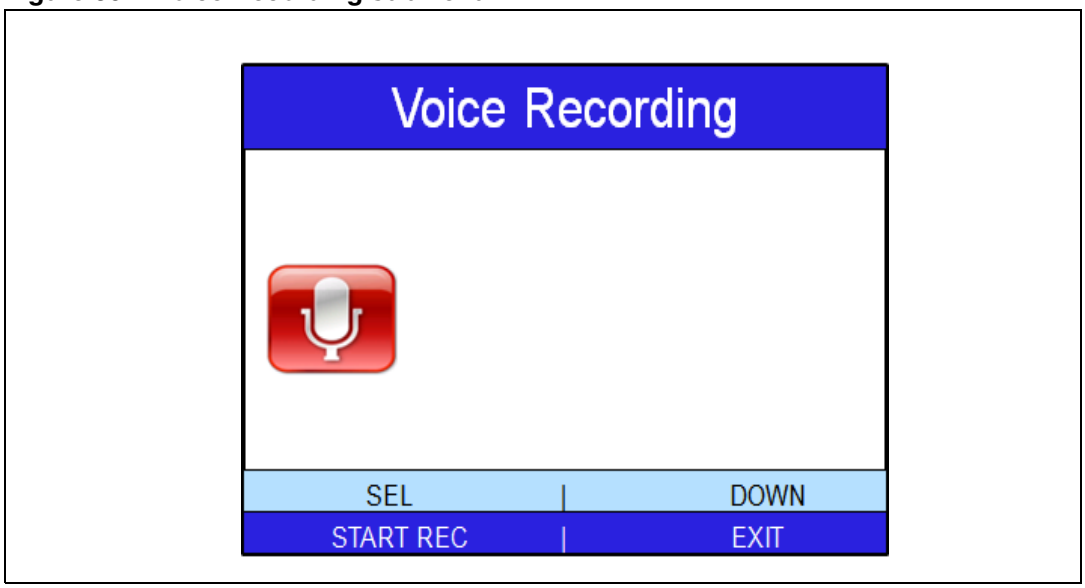
When the Voice Recording submenu is selected, the message shown in *Figure 38* is displayed on the LCD.

Figure 38. Voice Recording submenu selected



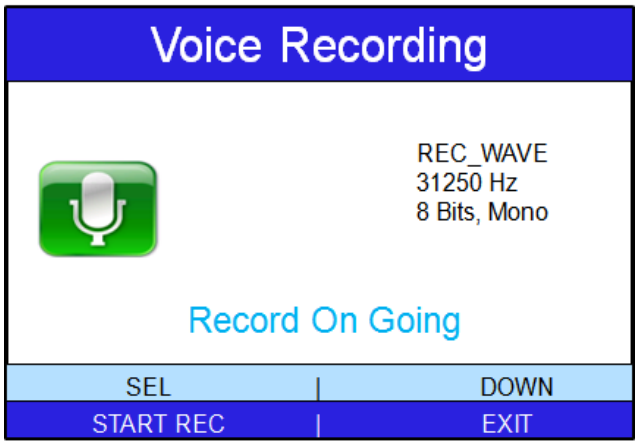
If the Record submenu has been selected by pressing the SEL push-button, the Voice Recording interface is displayed, as shown in *Figure 39*.

Figure 39. Voice Recording submenu



Once the record command is activated (by pressing the SEL push-button), the submenu shown in *Figure 40* is displayed.

Figure 40. Starting voice record



The recorded wave file properties are displayed on the right side of the submenu.

When the DOWN push-button is pressed, the menu in *Figure 38* is displayed. If the Player submenu has been selected by pressing the SEL push-button, the submenu shown in *Figure 37* is displayed.

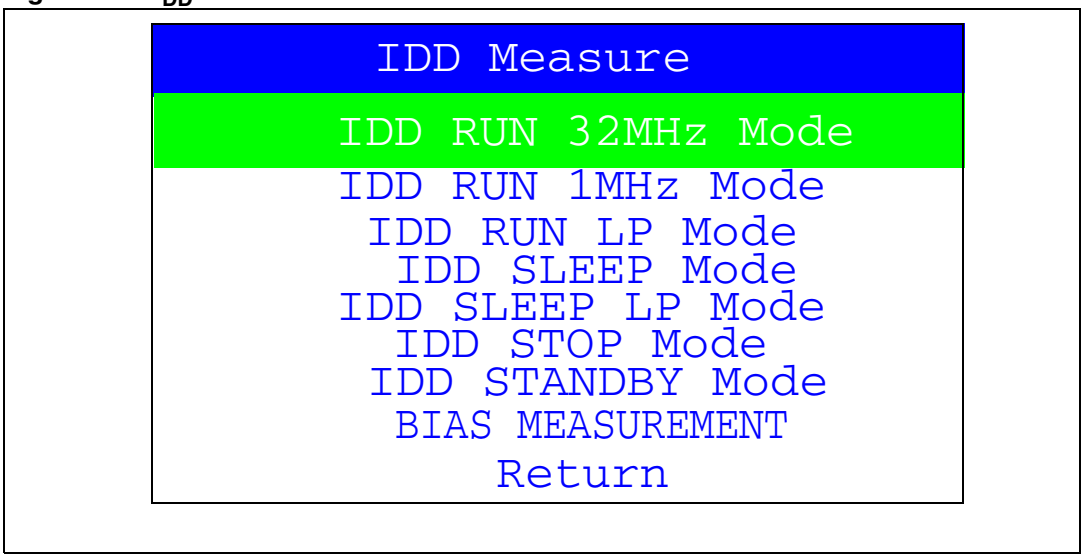
2.4.6 IDD Measure

The STM32L152ZD(T6) microcontroller provides several operating modes reducing power consumption. The purpose of this menu is to use the ADC peripheral features to measure the I_{DD} current in Run 32MHz, Run 1MHz, Run LP, Sleep, Sleep LP, Stop and Standby modes, and to measure the Bias current using the I_{DD} measurement circuit available on the STM32L152ZD-EVAL board.

During all IDD Measure applications, the V_{DD} is measured in real time using the ADC Internal V_{REF} measurement. This value is used to compute the I_{DD} current.

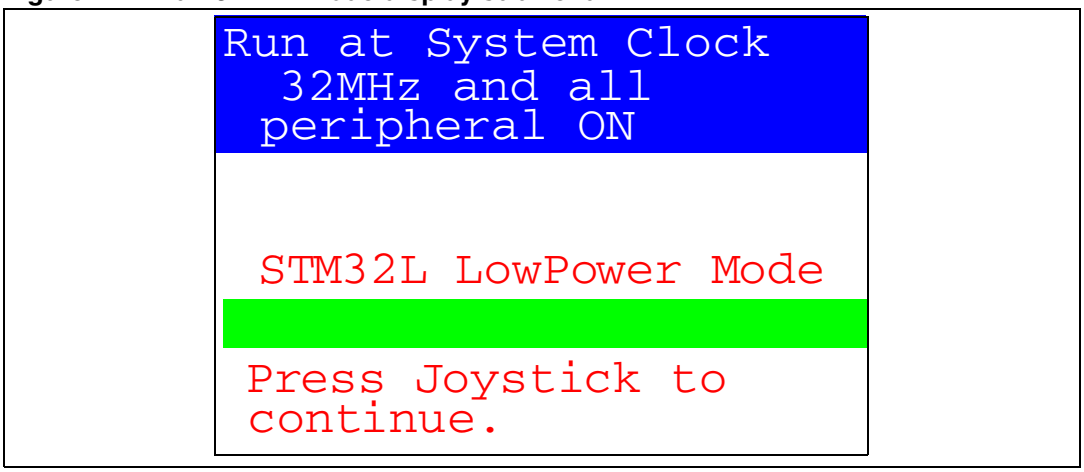
Select the IDD Measure menu by pressing SEL from the main menu. The message shown in *Figure 41* is then displayed on the LCD screen.

Figure 41. I_{DD} Measure menu



- If the IDD RUN 32MHz Mode submenu is selected, the RUN message is displayed on the LCD Glass and the message shown in *Figure 42* is displayed on the LCD screen.

Figure 42. Run 32MHz Mode display submenu



The I_{DD} value is displayed on the LCD screen until the joystick push-button is pressed. Once the joystick push-button is pressed, the MCU exits the IDD RUN 32MHz Mode submenu, the STM32L message is displayed on the LCD Glass and the message shown in *Figure 41* is displayed on the LCD screen.

- If the IDD RUN 1MHz Mode submenu is selected, the STM32L message is displayed on the LCD Glass and the message shown in *Figure 43* is displayed on the LCD screen.

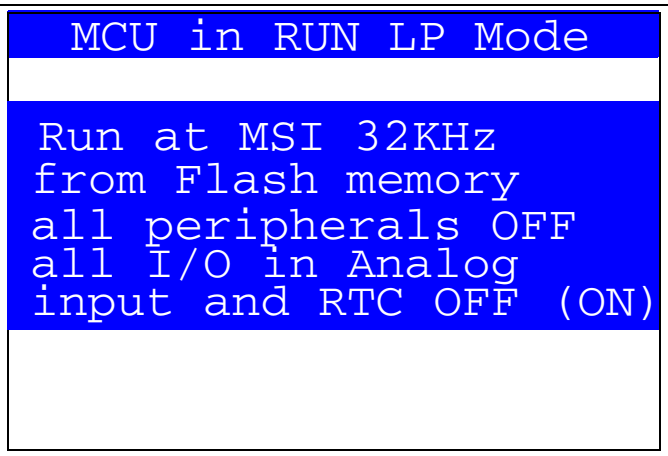
Figure 43. Run 1MHz Mode display submenu

The I_{DD} value is displayed on the LCD screen until the joystick push-button is pressed. Once the joystick push-button is pressed, the MCU exits the IDD RUN 1MHz Mode submenu, the STM32L message is displayed on the LCD Glass and the message shown in *Figure 41* is displayed on the LCD screen.

- If the IDD RUN LP Mode submenu is selected, the RUN LP message is displayed on the LCD Glass and the message shown in *Figure 44* is displayed on the LCD screen. Press SEL push-button to keep RTC peripheral ON during RUN LP mode, else press any other key push-button to stop RTC during this mode. Once pressed, the message shown in *Figure 45* is displayed on the LCD. The MCU enters in Run LP mode and waits for the rising edge on PA0 that can be generated by the external counter to exit the MCU from Run LP.

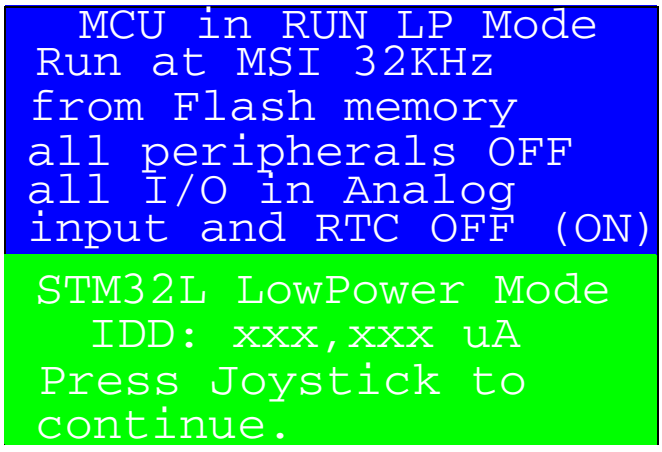
Figure 44. RTC ON or OFF Selection submenu

Figure 45. Enter Run LP Mode submenu



When the external rising edge is generated on PA0, the MCU exits the Run LP Mode, the STM32L message is displayed on the LCD Glass and the message shown in *Figure 46* is displayed on the LCD screen.

Figure 46. Run LP Mode display submenu

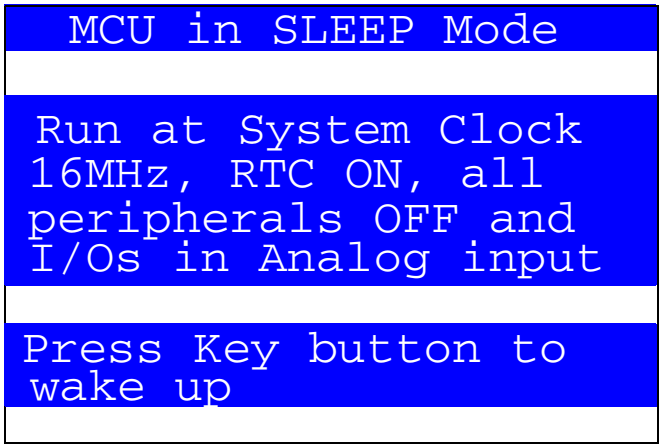


Once the joystick push-button has been pressed, the MCU exits the IDD RUN LP Mode submenu and the message shown in *Figure 41* is displayed on the LCD screen.

Note: After executing the Run LP Mode submenu, if the RTC is OFF, you have to re-configure the time, date and alarm (Refer to Calendar menu).

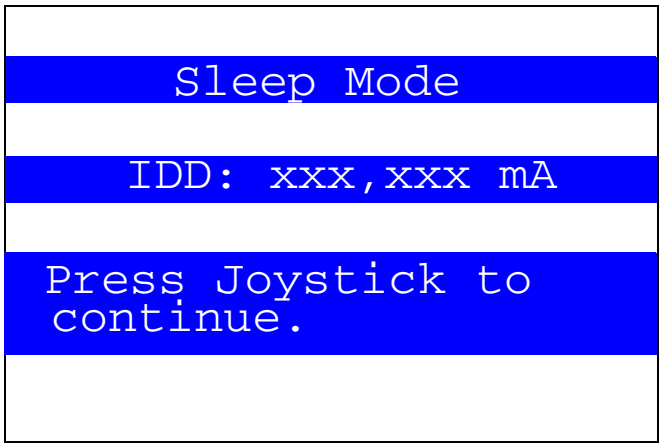
- If the IDD SLEEP Mode submenu is selected, the SLEEP message is displayed on the LCD Glass and the message shown in *Figure 47* is displayed on the LCD screen. The MCU enters in SLEEP mode and waits for the rising edge on PA0 (push-button) to exit the SLEEP mode.

Figure 47. Enter Sleep Mode submenu



When the user generates the external rising edge on PA0 by pressing the push-button, the MCU exits the SLEEP mode, the STM32L message is displayed on the LCD Glass and the IDD is displayed on the LCD screen as shown in *Figure 48*.

Figure 48. Sleep Mode display submenu

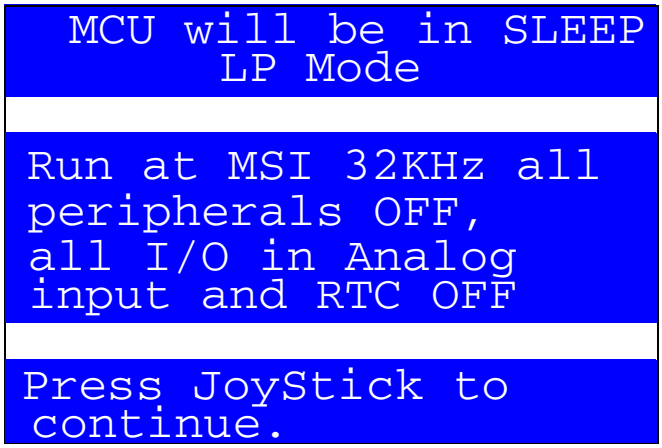


Once the joystick push-button has been pressed, the MCU exits the IDD Sleep Mode submenu and the message shown in *Figure 41* is displayed on the LCD screen.

Note: When Sleep mode is entered, the system clock is configured to run at 16 MHz, all peripherals are OFF, all I/Os are configured as analog inputs, the ultralow power feature is enabled, and the FLASH memory is in power-down.

- If the IDD SLEEP LP Mode submenu is selected, the message shown in *Figure 49* is displayed. Press SEL push-button to keep RTC peripheral ON during SLEEP LP mode, else press any other key push-button to stop RTC during this mode. Once pressed, the message shown in *Figure 50* is displayed on the LCD.

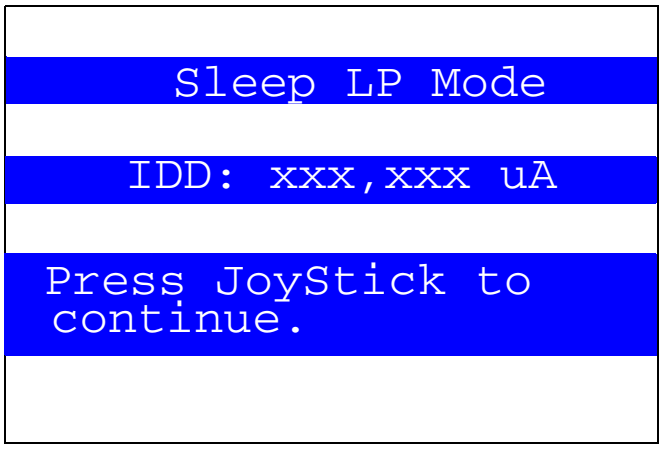
Figure 49. Enter Sleep LP Mode submenu



Once the joystick push-button has been pressed, the MCU enters in Sleep LP mode and waits for the rising edge on PA0, that can be generated by the external counter, to exit the MCU from SLEEP LP mode.

When the external rising edge is generated on PA0, the MCU exits the Sleep LP Mode and the message shown in *Figure 50* is displayed on the LCD screen.

Figure 50. Sleep LP Mode display submenu



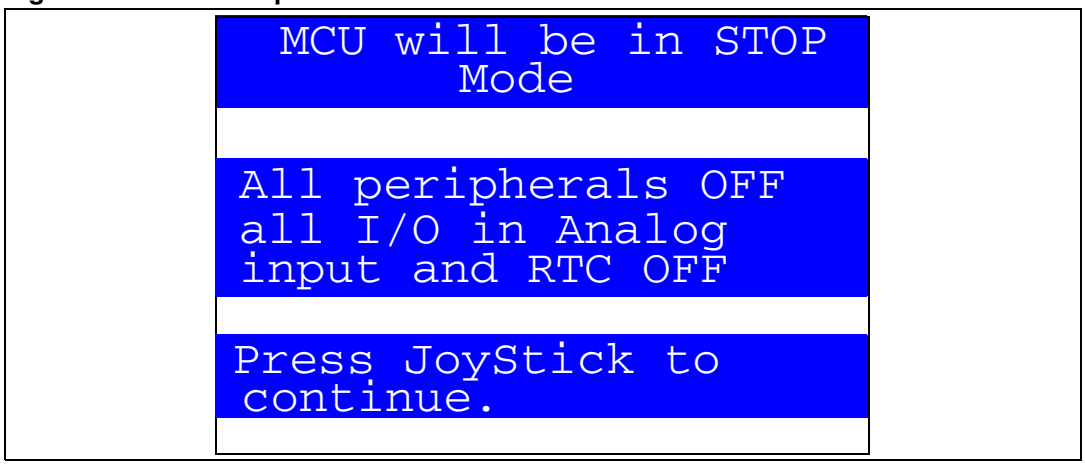
Once the joystick push-button has been pressed, the MCU exits the IDD Sleep LP Mode submenu and the message shown in *Figure 41* is displayed on the LCD screen.

Note: When Sleep LP mode is entered, the system clock is configured to run at MSI 32 KHz, all peripherals are OFF, all I/Os are configured as analog inputs, the RTC is set to OFF, the ultralow power feature is enabled, and the FLASH memory is in power-down.

After executing the Sleep LP Mode submenu, the RTC is OFF. Refer to Calendar menu to re-configure the time, date and alarm.

- If the IDD STOP Mode submenu is selected, the STOP message is displayed on the LCD Glass and the message shown in *Figure 51* is displayed on the LCD screen.

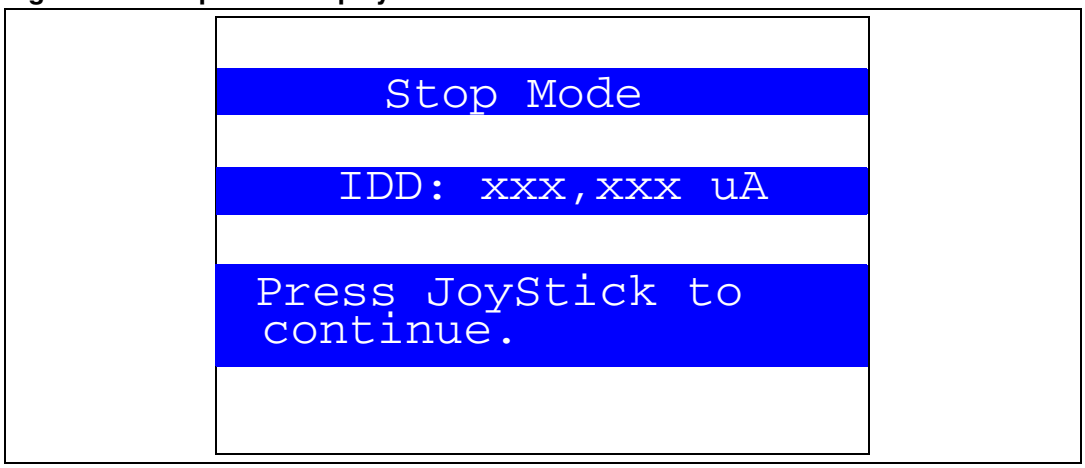
Figure 51. Enter Stop Mode submenu



Once the joystick push-button has been pressed, the MCU enters in Stop mode and waits for the rising edge on PA0, that can be generated by the external counter, to exit the MCU from Stop mode.

When the external rising edge is generated on PA0, the MCU exits the Stop mode, the STM32L message is displayed on the LCD Glass and the message shown in *Figure 52* is displayed on the LCD screen.

Figure 52. Stop Mode display submenu



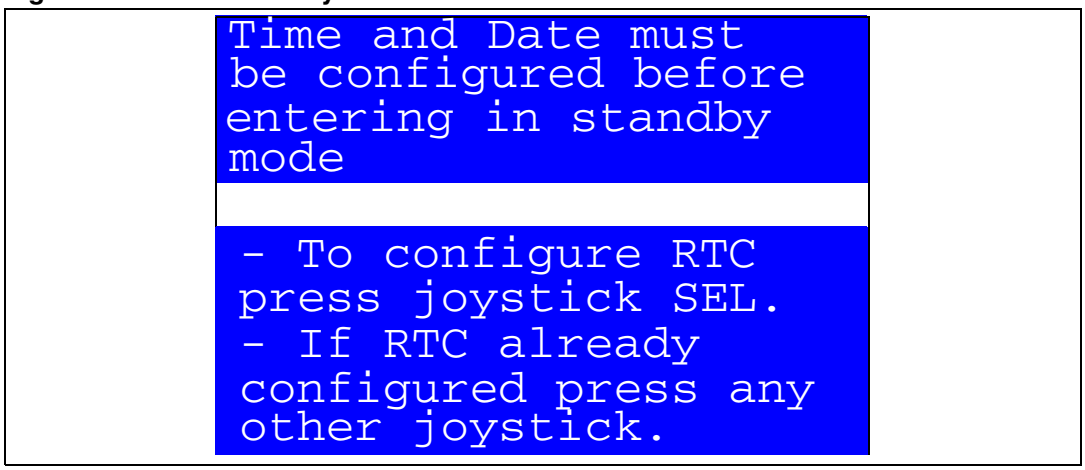
Once the joystick push-button has been pressed, the MCU exits the IDD Stop Mode submenu and the message shown in *Figure 41* is displayed on the LCD screen.

Note: When Stop mode is entered, all peripherals are OFF, all I/Os are configured as analog inputs and the RTC is OFF.

After executing the Stop Mode submenu, if the RTC is OFF, you have to re-configure the time, date and alarm (Refer to Calendar menu).

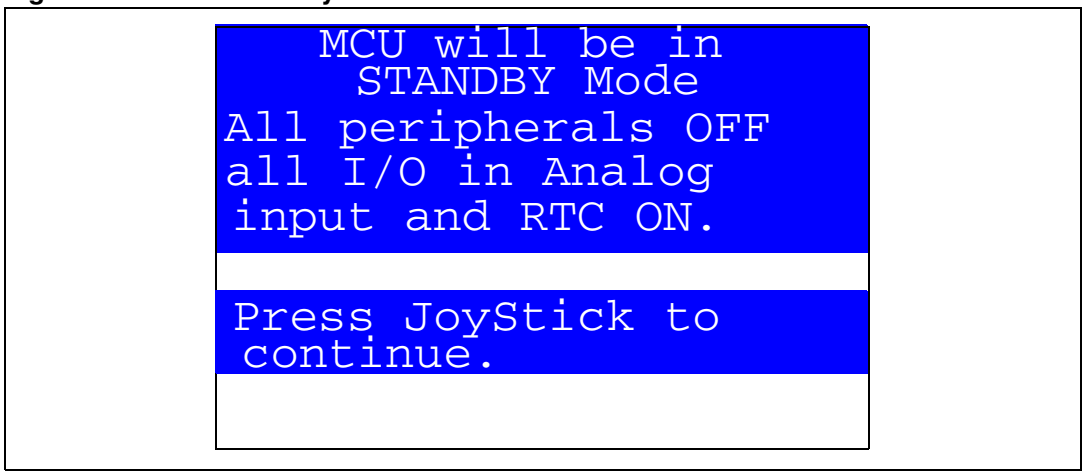
- If the IDD STANDBY Mode submenu is selected, the STANDBY message is displayed on the LCD Glass and the message shown in *Figure 53* is displayed on the LCD screen. Press SEL push-button to keep RTC peripheral ON during STANDBY mode, else press any other key push-button to stop RTC during this mode. Once pressed, the message shown in *Figure 54* is displayed on the LCD.

Figure 53. Enter Standby Mode submenu-1



Once the RTC is configured and the joystick push-button has been pressed, the message shown in *Figure 54* is displayed.

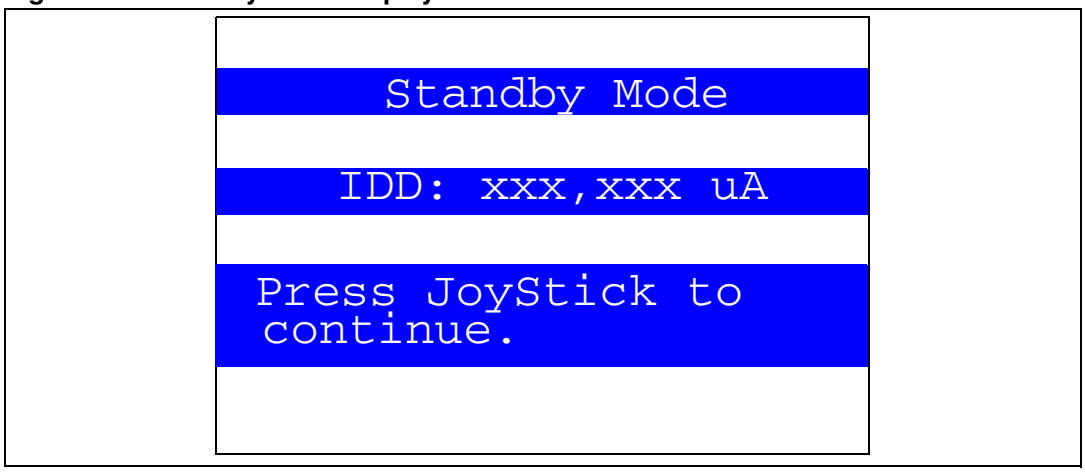
Figure 54. Enter Standby Mode submenu-2



Once the joystick push-button has been pressed, the MCU enters in Standby mode and waits for the rising edge on PA0, that can be generated by the external counter, to exit the MCU from STANDBY mode.

When the external rising edge is generated on PA0, the MCU exits the Standby mode, the system reset is generated and the message shown in *Figure 55* is displayed on the LCD screen.

Figure 55. Standby Mode display submenu

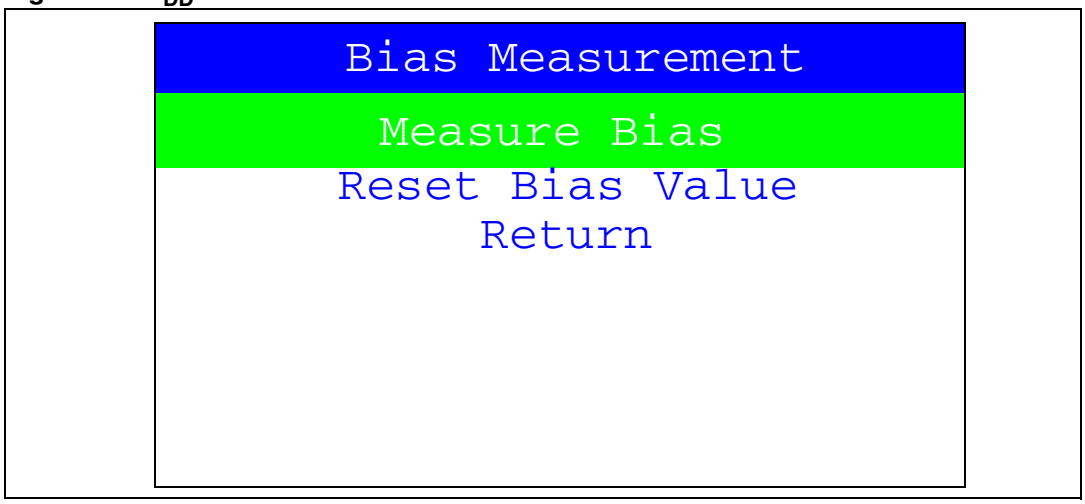


Once the joystick push-button has been pressed, the MCU continues the initialization as illustrated in *Section 2.1.1: Demo startup*.

- Bias Measurement: In Low power mode, the bias current of an operational amplifier input is not negligible as compared to the IDD current (typical Ibias is ~240 nA). To obtain a reliable MCU IDD measurement, it is possible to subtract the bias current from the IDD low power measurement, since this current is not sinked by the MCU.

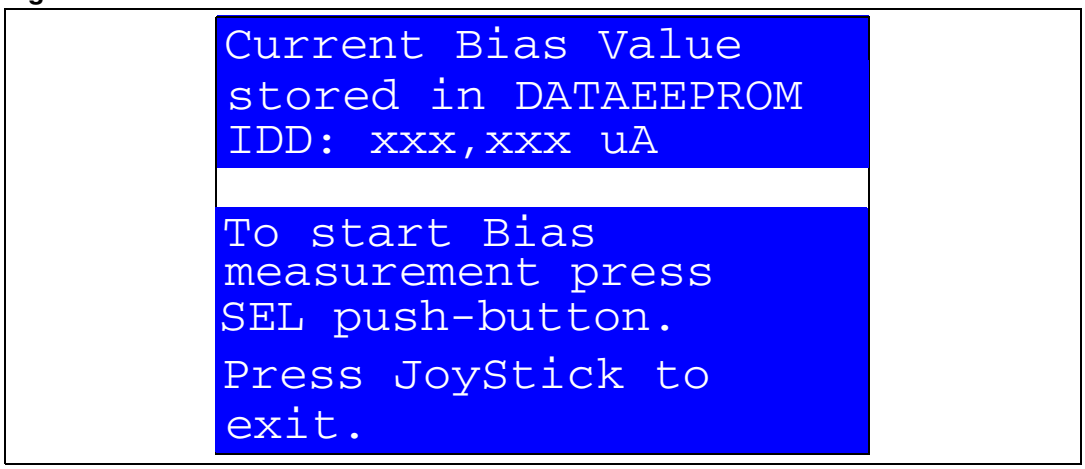
Select the Bias Measurement menu by pressing SEL from the IDD Measure menu. The message shown in *Figure 56* is then displayed on the LCD screen.

Figure 56. I_{DD} Bias Measurement menu



- If the Measure Bias Mode submenu is selected, the BIAS message is displayed on the LCD Glass and the message shown in *Figure 57* is displayed on the LCD screen.

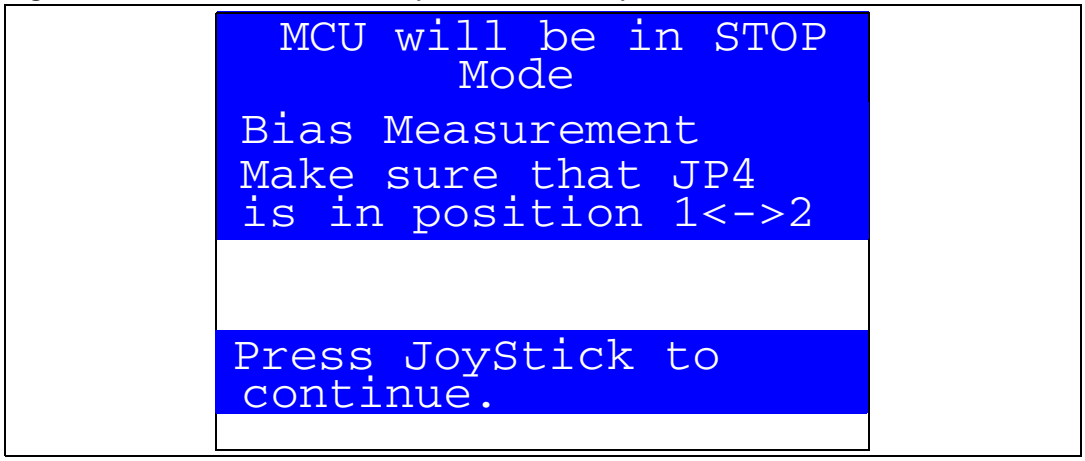
Figure 57. Measure Bias submenu



If the joystick push-button has been pressed, the MCU exits the Measure Bias submenu and the message shown in *Figure 56* is displayed on the LCD screen.

If the SEL push-button has been pressed, the MCU starts the Measure Bias submenu and the message shown in *Figure 58* is displayed on the LCD screen.

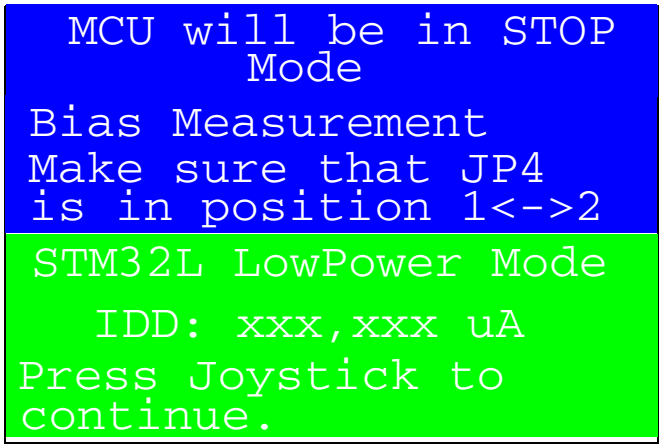
Figure 58. Measure Bias Mode (Procedure Start) submenu



Once the joystick push-button has been pressed, the MCU enters the Stop mode and waits for the rising edge on PA0, that can be generated by the external counter, to exit the MCU from Stop mode.

When the external rising edge is generated on PA0, the MCU exits the Stop mode, the STM32L message is displayed on the LCD Glass and the message shown in *Figure 59* is displayed on the LCD screen.

Figure 59. Stop Mode display submenu

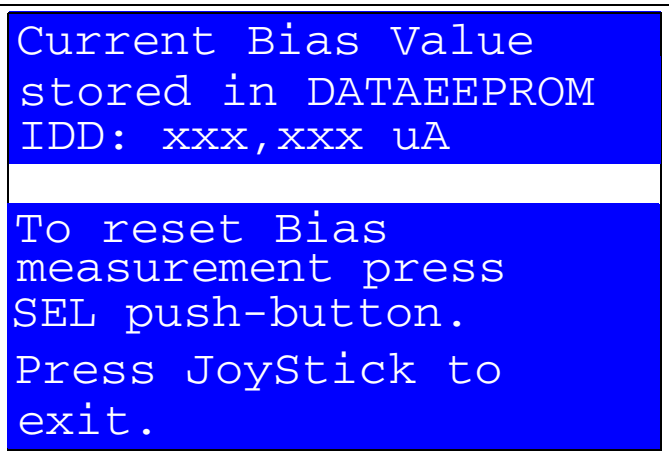


Once the joystick push-button has been pressed, the MCU exits the Bias Measure submenu and the message shown in *Figure 56* is displayed on the LCD screen.

The measured Bias value is stored in the internal DATA EEPROM memory. This value will be used with Low Power modes current measurement.

- If the Reset Bias Value submenu is selected, the BIAS message is displayed on the LCD Glass and the message shown in *Figure 60* is displayed on the LCD screen.

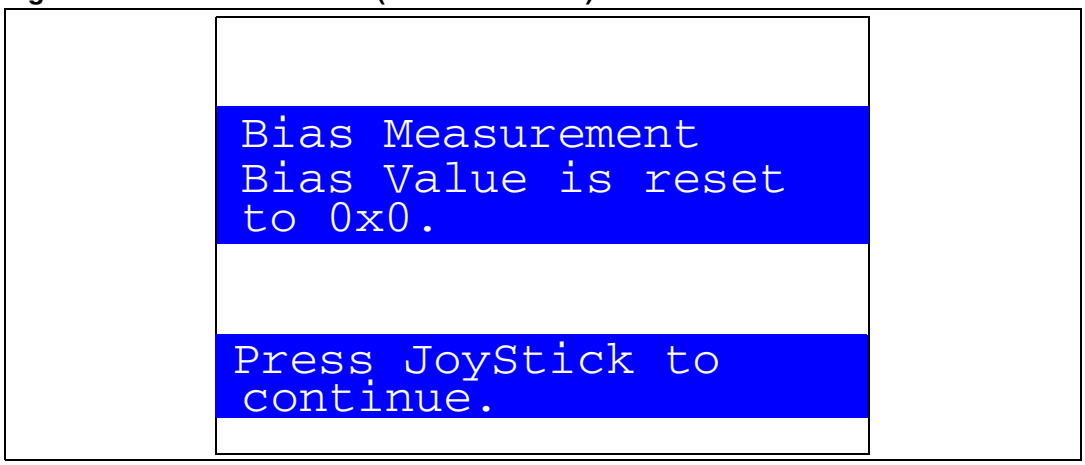
Figure 60. Reset Bias Value submenu



If the joystick push-button has been pressed, the MCU exits the Reset Bias Value submenu and the message shown in *Figure 56* is displayed on the LCD screen.

If the SEL push-button has been pressed, the MCU starts the Reset Bias Value submenu and the message shown in *Figure 61* is displayed on the LCD screen.

Figure 61. Reset Bias Value (Procedure Start) submenu



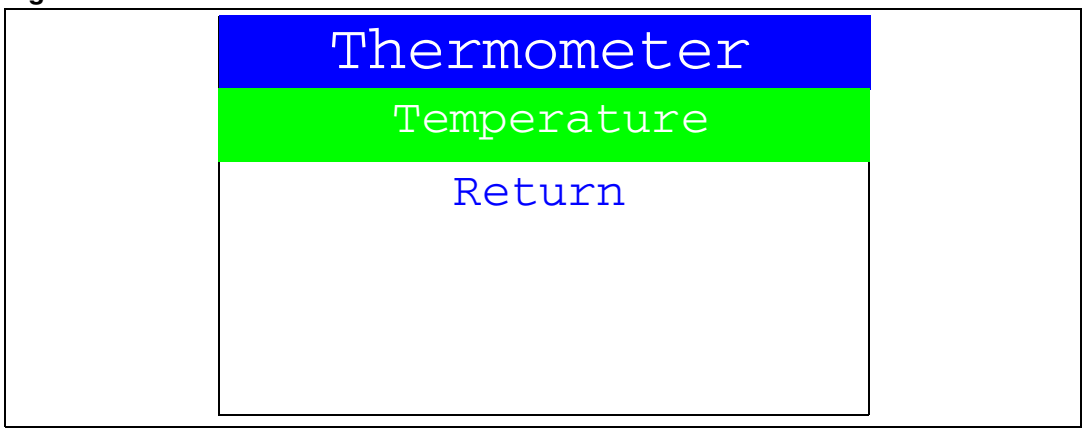
Once the joystick push-button has been pressed, the MCU exits the Reset Bias Value submenu and the message shown in *Figure 56* is displayed on the LCD screen.

2.4.7 Thermometer

The STM32L152ZD(T6) microcontroller has two embedded I^2C peripherals that can be connected to any device supporting the I^2C protocol including the System management bus (SMBus) mode. An STLM75 (or a compatible device) I^2C temperature sensor is mounted on the STM32L152D-EVAL board and used to capture the external temperature (-55°C to +125°C).

When the Thermometer submenu is selected, the message shown in *Figure 62* is displayed on the LCD.

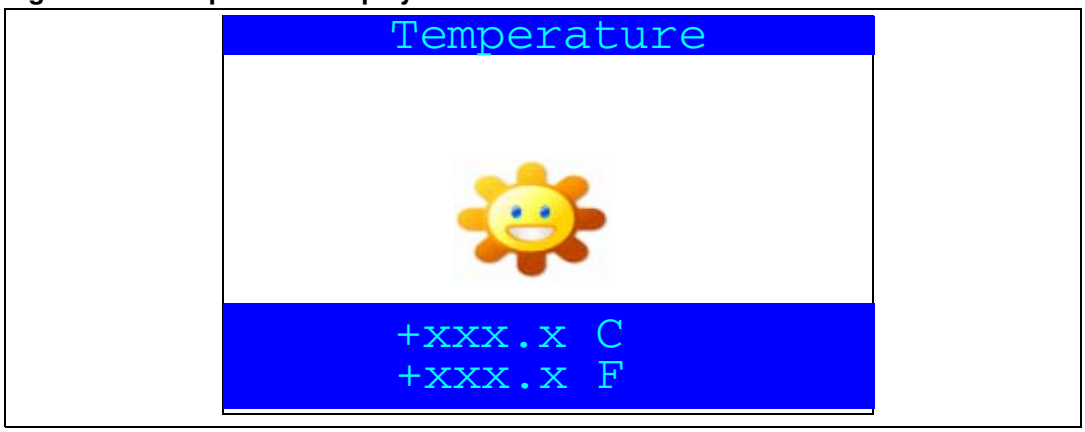
Figure 62. Thermometer submenu selected



Once the Temperature submenu has been selected by pressing the SEL push-button, the temperature value is displayed in Celsius and Fahrenheit, as shown in *Figure 63*.

Press any key to return to the Thermometer submenu.

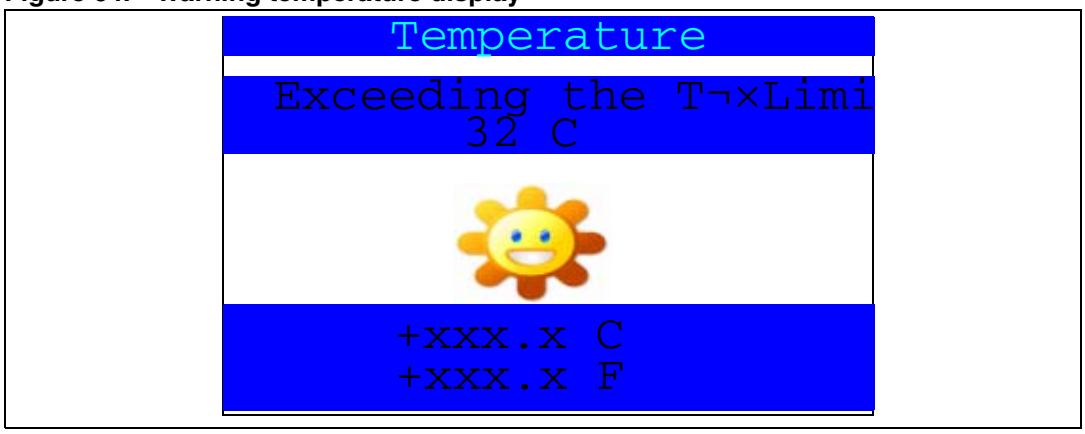
Figure 63. Temperature display



The temperature variations can be easily monitored using the STM32 I2C SMBus feature. This is managed by the SMBus Alert, which generates a dedicated interrupt informing the system that the temperature is out of the selected ranges. This can be very useful when a higher temperature needs an emergency action, as is the case in critical systems (motor control, medical...).

If the temperature exceeds the over-limit high (TEMPERATURE_TOS: Over Limit Temperature) the SMBus alert interrupt is generated and the warning message shown in *Figure 64* is displayed on the LCD screen.

Figure 64. Warning temperature display



The messages shown in *Figure 63* are displayed on the LCD screen when the temperature goes under the over limit low (TEMPERATURE_THYS: Hysteresis Temperature).

The user can configure the TOS and THYS using dedicated define values in the code. By default, the STM32L152D-EVAL demo sets them to (see menu.c file):

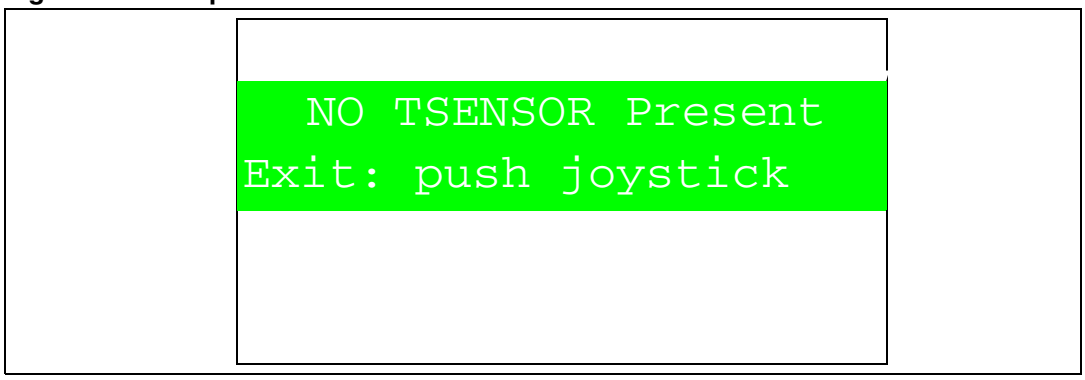
```
#define TEMPERATURE_THYS 31

#define TEMPERATURE_TOS 32
```

Press any key to return to the Thermometer submenu.

Note: Any hardware trouble with the temperature sensor is detected by a test. In such a case, the message shown in Figure 65 is displayed.

Figure 65. Temperature sensor error

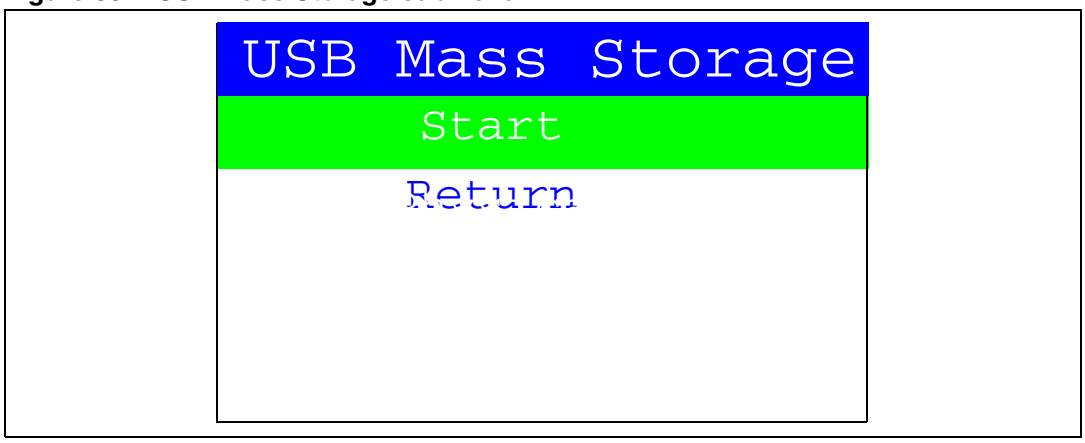


2.4.8 USB Mass Storage Submenu

The STM32L152ZD(T6) microcontroller features a USB (universal serial bus) that provides a full-speed interface to a USB host PC.

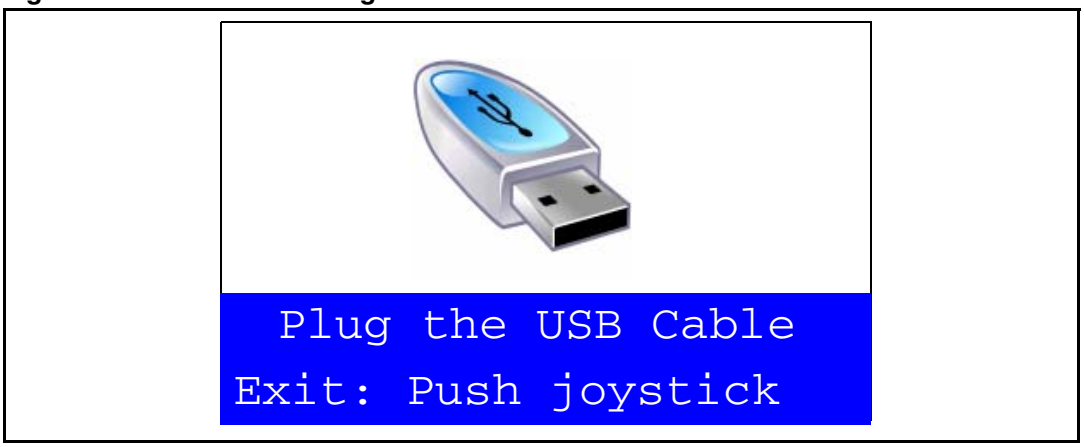
The USB Mass Storage submenu is used to configure the USB interface for communication with the PC and to run the mass storage demo using an MSD card.

Figure 66. USB Mass Storage submenu



If the SEL push-button is pressed when Start is selected, the message shown in *Figure 67* appears on the LCD screen until the cable is plugged in.

Figure 67. USB Mass Storage submenu selected



To return to the previous submenu, the user must connect a USB cable between the USB connector type B (CN15) and the PC. If the user connects a cable or presses any joystick push-button, the message shown in *Figure 68* is displayed on the LCD.

Figure 68. USB cable connected

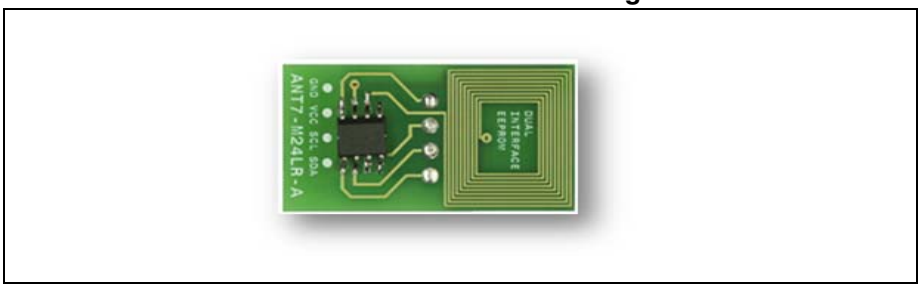
Once the cable has been connected, the PC recognizes the board as a mass storage device and consequently opens a window to show the contents of the MSD mounted on the STM32L152-EVAL board. The user can transfer files between the MSD and the PC.

2.4.9 Dual interface EEPROM (RF/I²C)

The STM32L152ZD(T6) microcontroller has two embedded I2C peripherals that can be connected to any device supporting the I2C protocol. An ANT7-M24LR-A dual interface RF EEPROM daughter board can be connected on CN12 to STM32L152D-EVAL via the I2C interface.

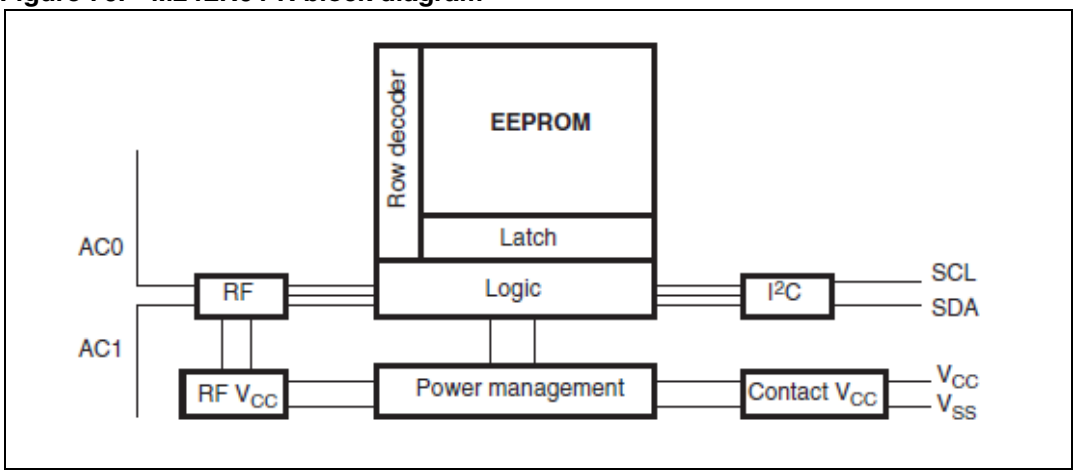
Note: For more details about the Dual Interface EEPROM daughter board, please refer to the ANT7-M24LR-A databrief.

Figure 69. ANT7-M24LR-A dual interface EEPROM daughter board



The M24LR64-R device is a dual-interface, electrically erasable programmable memory (EEPROM). It features an I2C interface and can be operated from a VCC power supply. It is also a contactless memory powered by the received carrier electromagnetic wave at 13.56 MHZ. The M24LR64-R is organized as 8192 × 8 bits in the I2C mode and as 2048 × 32 bits in the ISO 15693 and ISO 18000-3 mode 1 RF mode.

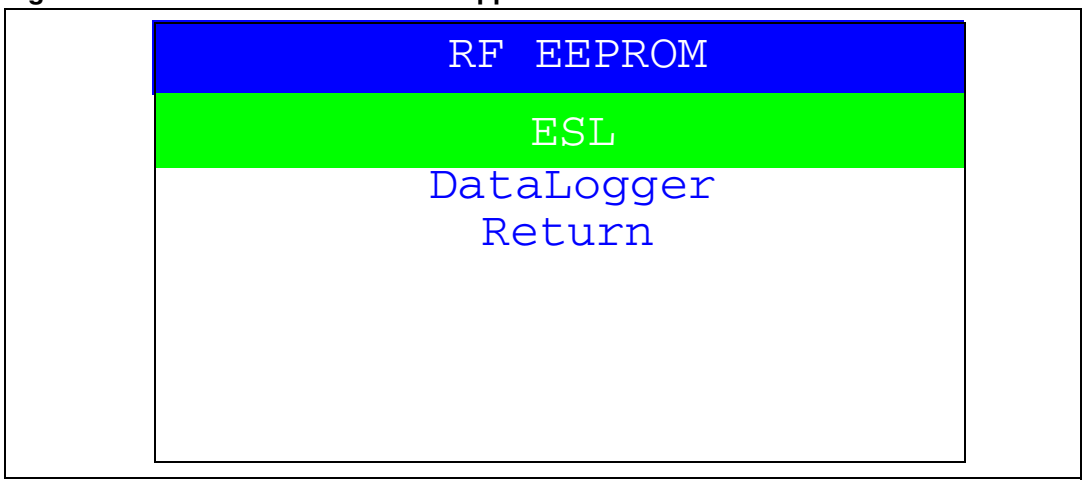
Figure 70. M24LR64-R block diagram



Note: For more details on the M24LR64 EEPROM, please refer to the datasheet.

Select the Dual Interface (RF/I²C) EEPROM menu by pressing SEL from the main menu. Two applications can be selected, as shown in *Figure 71.*

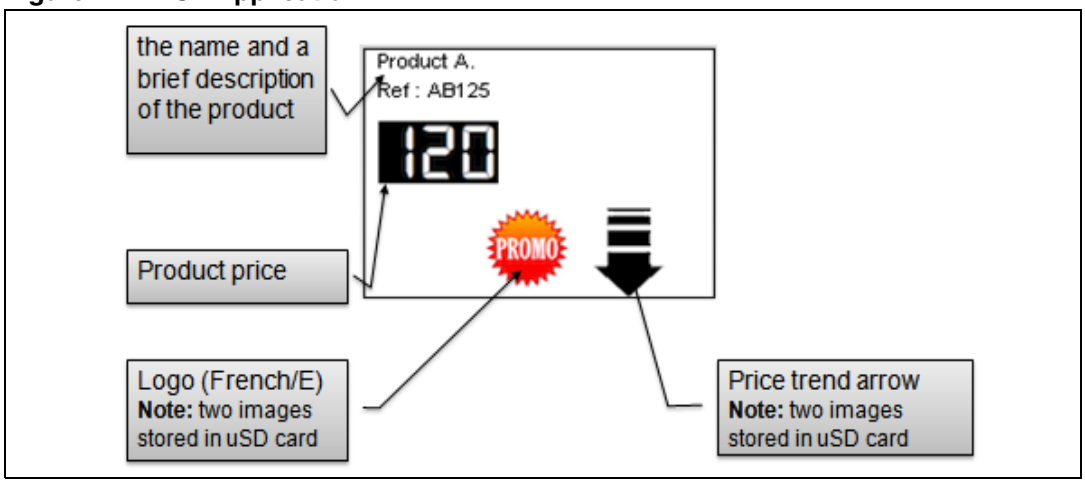
Figure 71. Dual Interface EEPROM applications menu



ESL application

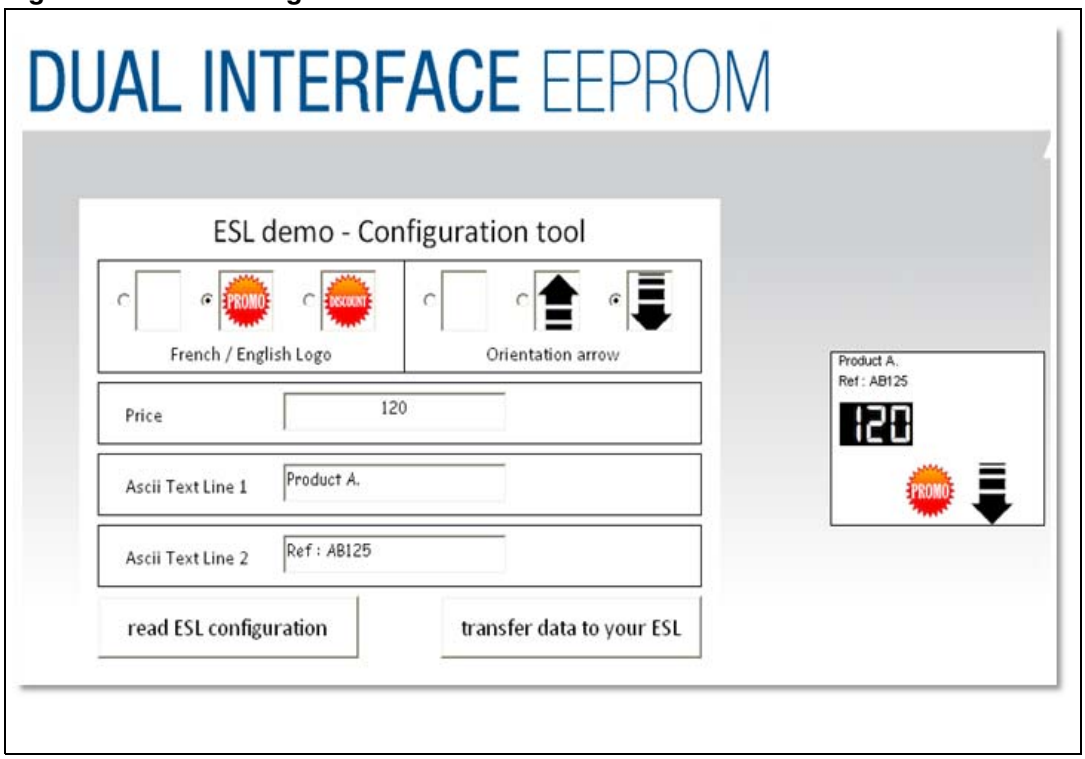
The Electronic Shelf Labeling (ESL) consists of reading (using I2C interface) the content of the dual interface EEPROM and displaying the information on the LCD screen, as shown in *Figure 72*.

Figure 72. ESL Application



All this information (product name, price, logo, price trend...) is programed in the M24LR64 dual interface EEPROM in RF mode and can be updated any time using the CR95HF RFID reader/writer connected to the USB port of a PC host, with the associated M24LRxx_Application_Software PC software.

Figure 73. ESL setting menu



Using this PC software application, several parameters can be set to configure the ESL device and update the LCD display mounted on the STM32L152D-EVAL:

French / English Logo: Check the French (PROMO) or English (DISCOUNT) to indicate that a special price is proposed. Check the blank logo if no special price is applied.

Orientation arrow: Check the up or down arrow to indicate if the price has been increased or decreased, or the blank arrow if no indication is required.

Price: Display the product price.

Ascii Text Line 1 and Line 2: Display the name and a brief description of the product.

The transfer data to your ESL button of the PC ESL demo software allows to program ESL parameters in RF mode using the CR95HF RFID reader/writer demo board.

ESL data can be read from the M24LR64 dual interface EEPROM using the **read ESL configuration** button of the PC ESL demo software application. When done, ESL data written into the M24LR64 is displayed in the ESL panel of the PC ESL demo application.

*Note: For more details about this PC Software, please refer to user manual **UM0853**.*

ESL parameters mapping into the M24LR64 dual interface EEPROM are shown in *Table 4: M24LR64 memory organization (ESL application)*.

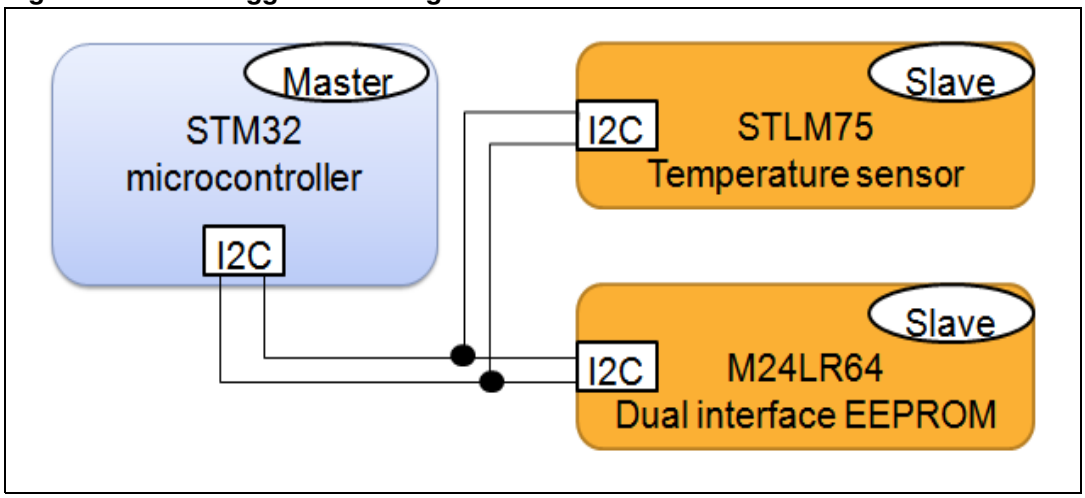
Table 4. M24LR64 memory organization (ESL application)

RF block address	Bits [31:24]	Bits [23:16]	Bits [15:8]	Bits [7:0]
0000h		Arrow	Icon	
0001h	Contains XYYYYYYYh X = number of digits (max 7) in price YYYYY = price value including decimal separator (.) coded in hexadecimal For instance, 512A99FFh means 5 digits and the price is 12.99			
0002h	Contains the ASCII codes of the string chain called ASCII TEXT LINE 1 in M24LR64 ESL demo software. The maximum size of this text line is 20 characters			
0003h				
0004h				
0005h				
0006h				
0007h	Contains the ASCII codes of the string chain called ASCII TEXT LINE 2 in M24LR64 ESL demo software. The maximum size of this text line is 20 characters			
0008h				
0009h				
000Ah				
000Bh				
000Ch	XXXX XX is the checksum of bytes from address 0000h to 000Bh YY: reserved ZZ: reserved			

DataLogger application

This dual interface EEPROM (RF/I²C) application presents a practical application for the M24LR64. It is able to record and store a 64-Kbit temperature data using the M24LR64-R dual interface EEPROM. The DataLogger microcontroller is an STM32L152ZD (T6) which communicates with the M24LR64-R using its I²C serial interface and controls an STLM75 digital temperature sensor.

Figure 74. DataLogger block diagram



Temperature acquisition parameters (temperature acquisition Start/Stop, temperature acquisition period) are stored into the M24LR64 dual interface EEPROM. Changing these values and controlling the temperature acquisition is done in RF mode using the CR95HF RFID reader/writer demo board. During the temperature acquisition, data from the STLM75 digital temperature sensor is written into the M24LR64 by the STM32L152ZD microcontroller in I²C mode and displayed on the STM32L252 eval board LCD screen.

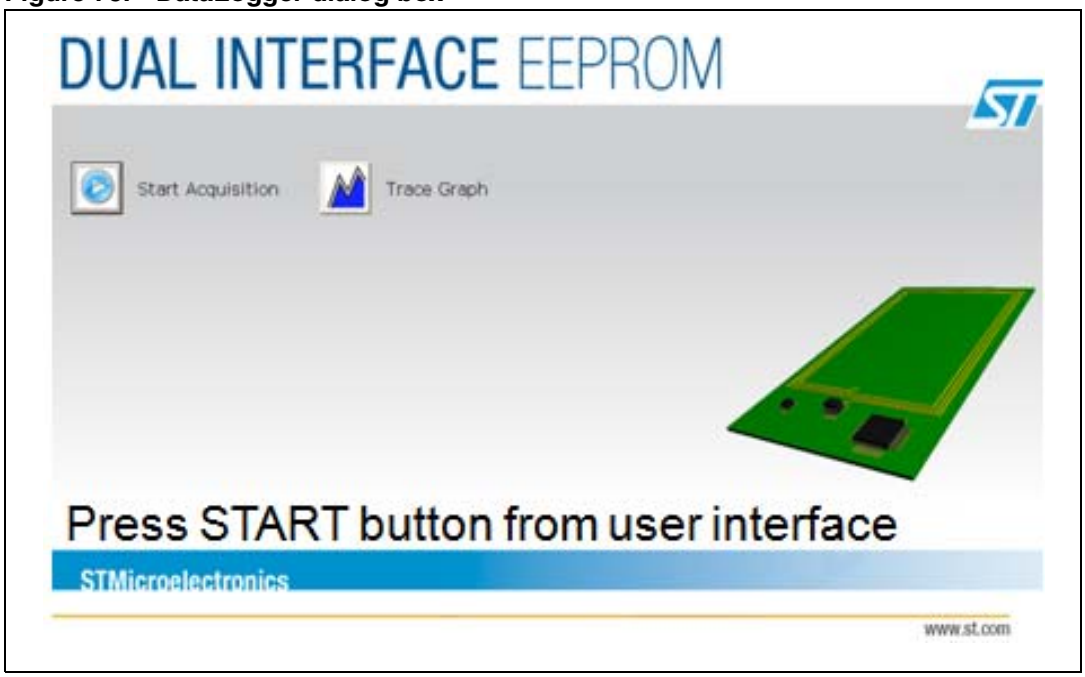
Temperature data can be read in the same time in RF mode using the CR95HF RFID reader/writer demo board and be displayed in the PC DataLogger software application.

For more details about this application, please refer to the application note AN 3109 “Developing your M24LR64-R datalogger application for temperature acquisition“.

How to run the application:

1. From the STM32L125D evaluation board, select the DataLogger submenu and then press the SEL push-button.

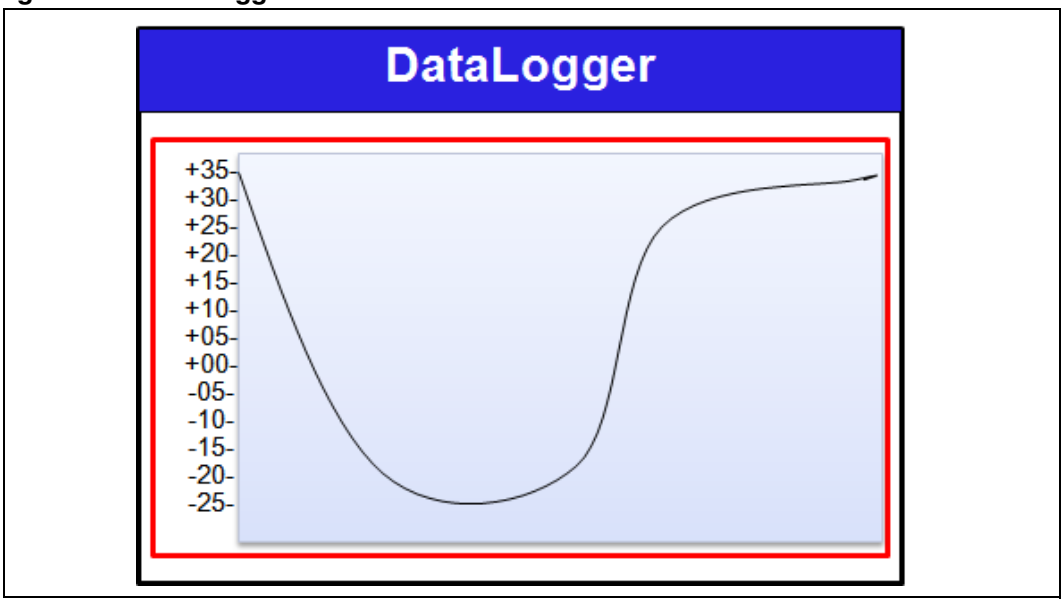
Figure 75. DataLogger dialog box



2. From the application software side, choose “DataLogger“ application and then follow the steps described on the user manual, UM0925.

When the application starts, the data has been stored in the dual interface EEPROM and this temperature data has been displayed as a real-time curve on the TFT-LCD mounted on the evaluation board and also on the PC software interface.

Figure 76. DataLogger curve



Reference documents:

a) M24LR64-R datasheet
b) M24LR64-R tool driver install guide user manual (UM0863)
c) Using the M24LR64-R datalogger reference design user manual (UM0925)
d) How to manage M24LR64-R data transfers from the I²C bus or an RF channel
e) Application note (AN3057)
f) Application note (AN3109)
g) ANT7-M24LR-A data brief

For more information about dual interface EEPROM memories and associated demo boards and documentation, visit the dual interface EEPPROM page on www.st.com.

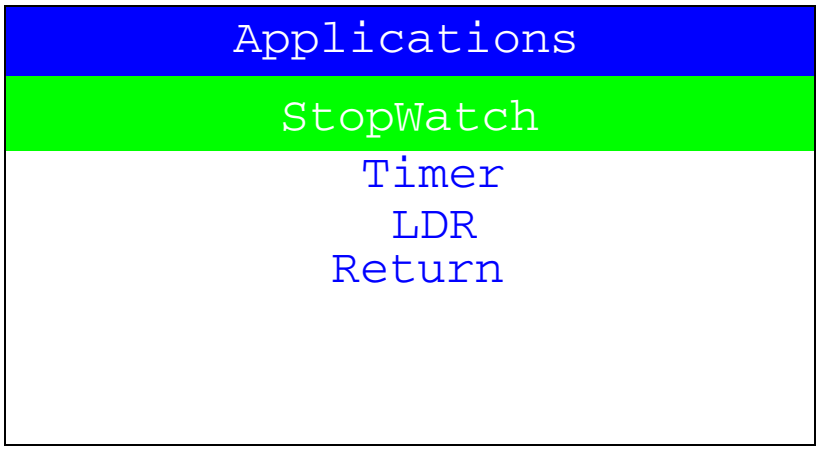
For more information about the CR95HF multi protocol RFID transceiver technical documentation and associated resources, visit the CR95HF web page on www.st.com.

2.4.10 Applications

The STM32L152ZD(T6) microcontroller has a new embedded RTC Version 2 which can be used for many applications, such as StopWatch and Timer.

Select Applications to display the submenu shown in *Figure 77*.

Figure 77. Applications menu



StopWatch application

This application simulates a precise chronometer with 5 record time possibilities stored in the Backup registers (5 registers for time - seconds, minutes and hours) and 5 registers for sub-seconds). For this application, an interactive human interface is developed using STM32L152D_EVAL's LCD and push-buttons, to allow the user to use StopWatch with real-time display.

Figure 78. StopWatch submenu

After startup, a default 00:00:00:000 chronometer counter is displayed on the LCD, corresponding to [Hours]:[minutes]:[seconds]:[milliseconds].

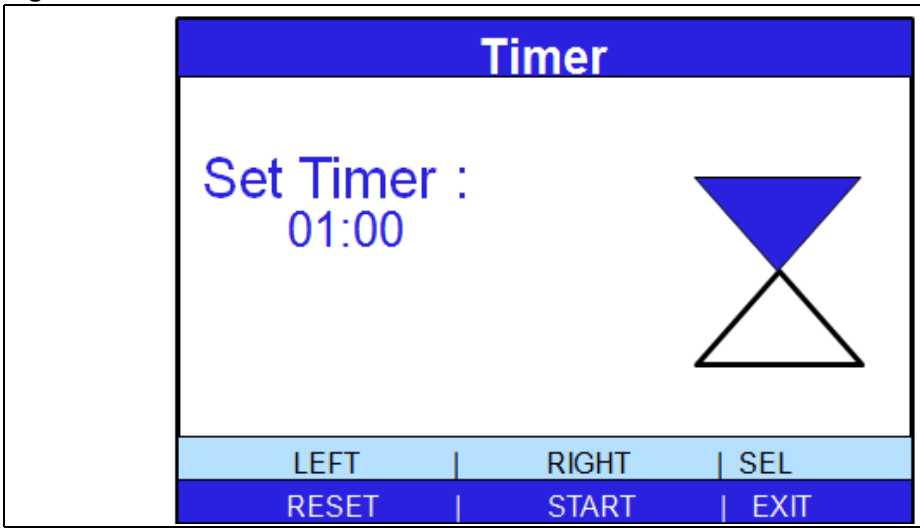
The user can manipulate the chronometer features using the joystick LEFT, RIGHT and DOWN push-buttons:

- press the joystick LEFT button to start the counter.
- press the joystick RIGHT button to save trials in the backup registers (max 5 actions).
- Press the joystick DOWN button to exit.
- press and hold the Tamper button for 1 sec to reset all the backup registers.

Timer application

This application simulates a precise Hourglass. It measures the passage of a few time units (sub-seconds, seconds or minutes). For this application, an interactive human interface has been developed using STM32L152D_EVAL's LCD and push-buttons to allow the user to use StopWatch with real-time display. After startup, the Hourglass is full and the default timer is one minute. Using the UP and DOWN push-buttons, the user can change the Timer duration (the timer duration must be higher than 13 seconds).

Figure 79. Timer submenu



The user can manipulate the Hourglass features using the joystick LEFT, RIGHT, UP and DOWN buttons:

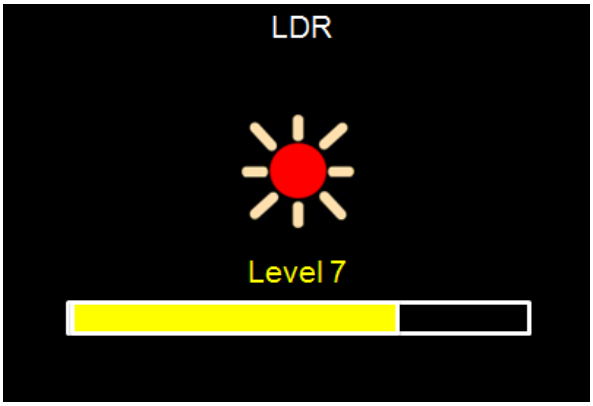
- press the joystick RIGHT button to start the timer.
- press again the joystick RIGHT button to stop the timer.
- press the joystick LEFT button to reset the timer.
- press the joystick UP/DOWN button to adjust the timer (UP and DOWN are only used when the Timer is reset).

LDR application

The STM32L152ZD(T6) microcontroller has an embedded comparator which can be used in combination with the DAC peripheral for more applications, such as the measuring of light intensity (using the LDR sensor).

When the LDR submenu is selected, the message shown in *Figure 80* is displayed.

Figure 80. Light Intensity Level



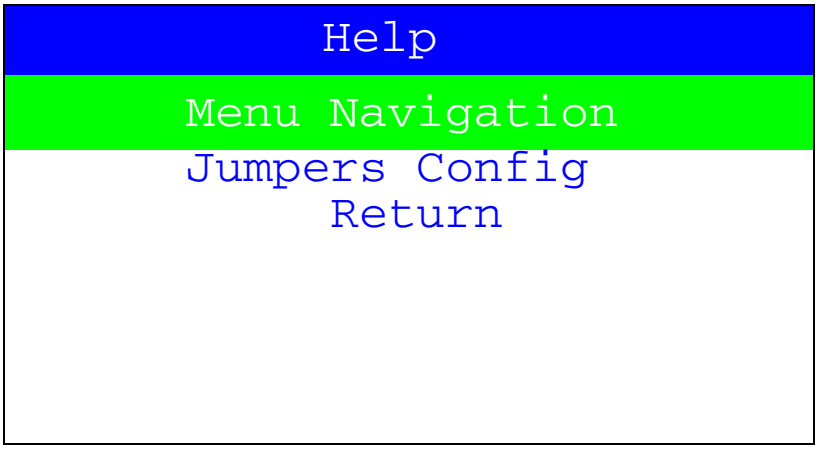
According to the light intensity level, the icons are changed and also the progress bar.

2.4.11 Help

This submenu can help the user to configure the jumpers on the STM32L152-EVAL evaluation board and to navigate between the menus and submenus available in the firmware demo.

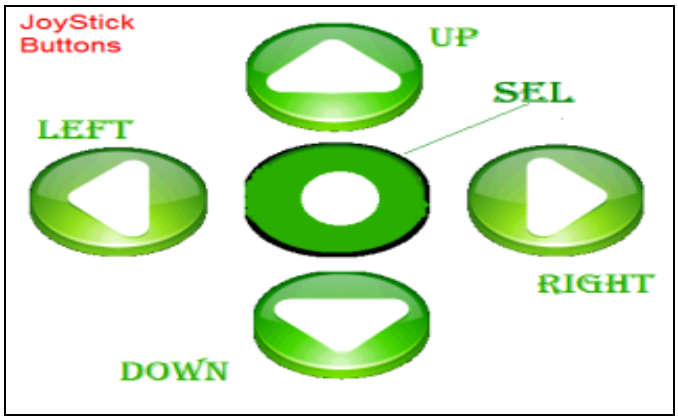
Select the Help menu by pressing SEL from the main menu. The message shown in *Figure 81* is then displayed on the LCD screen.

Figure 81. Help menu



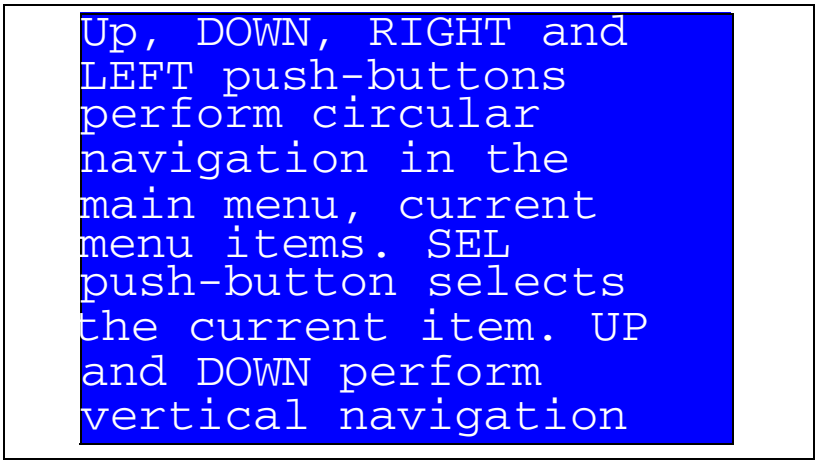
- If Menu Navigation submenu is selected, the message shown in *Figure 82* is displayed.

Figure 82. Navigation menu-1



When any joystick button is pressed, the second navigation interface is displayed, as shown in *Figure 83.*

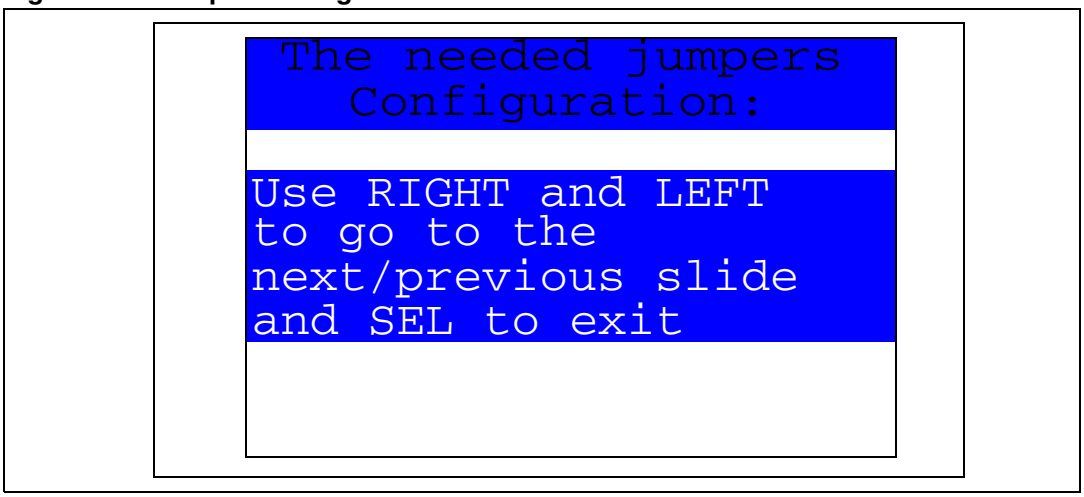
Figure 83. Navigation menu-2



Once the joystick push-button has been pressed again, the MCU exits the navigation submenu and the message shown in *Figure 81* is displayed on the LCD screen.

- If the Jumpers config submenu is selected, the message shown in *Figure 84* is displayed.

Figure 84. Jumpers config menu-1



Press RIGHT and LEFT to go to the next/previous slide and SEL to exit. The following messages shown in *Figure 85*, *Figure 86, Figure 87* and *Figure 88* are displayed sequentially on the LCD screen.

Figure 85. Jumpers config menu-2

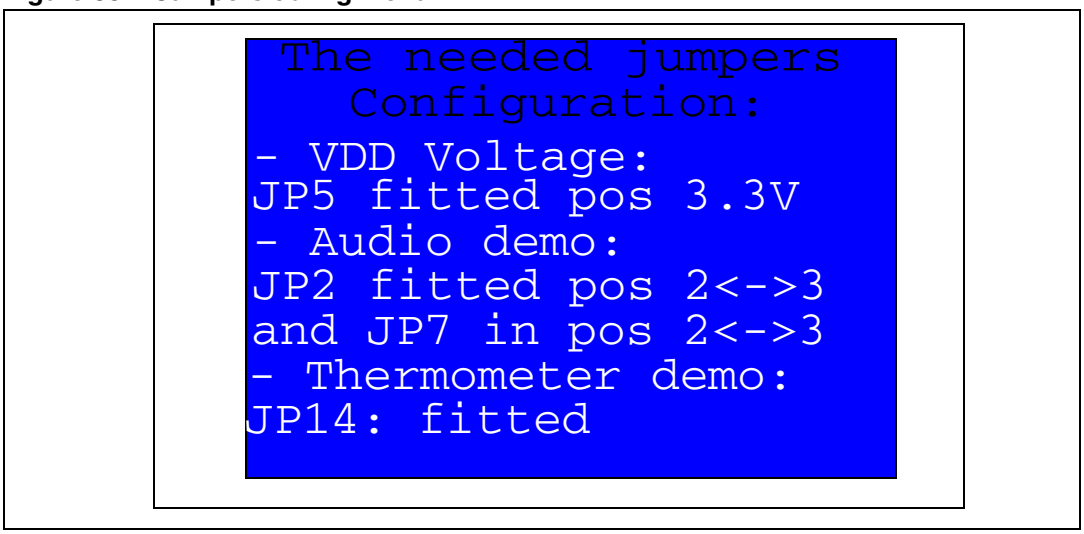


Figure 86. Jumpers config menu-3

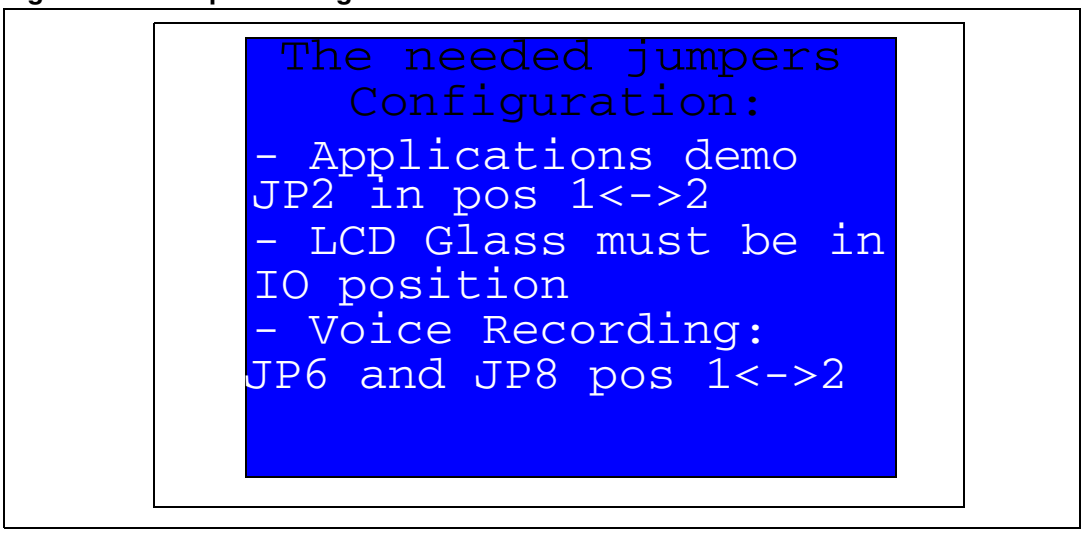


Figure 87. Jumpers config menu-4

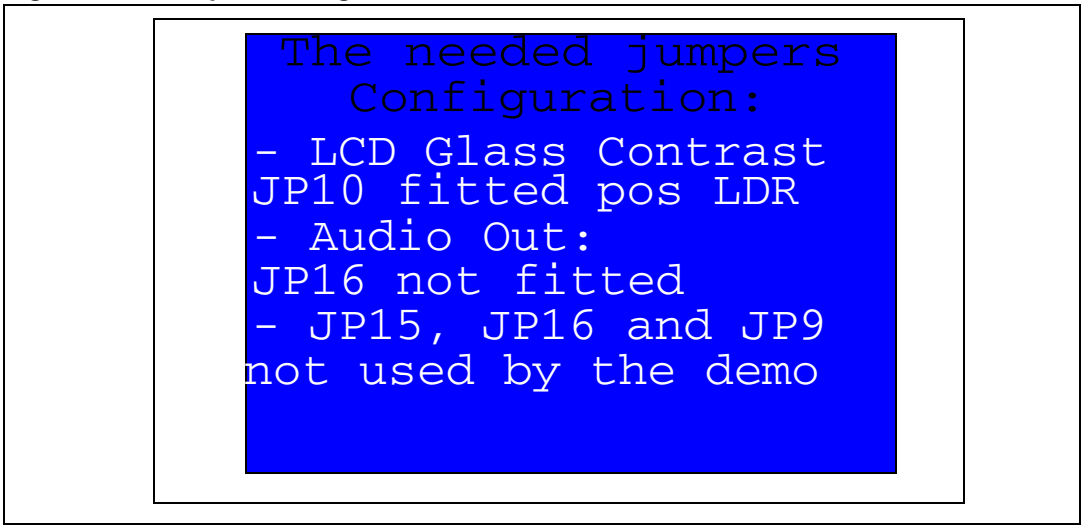
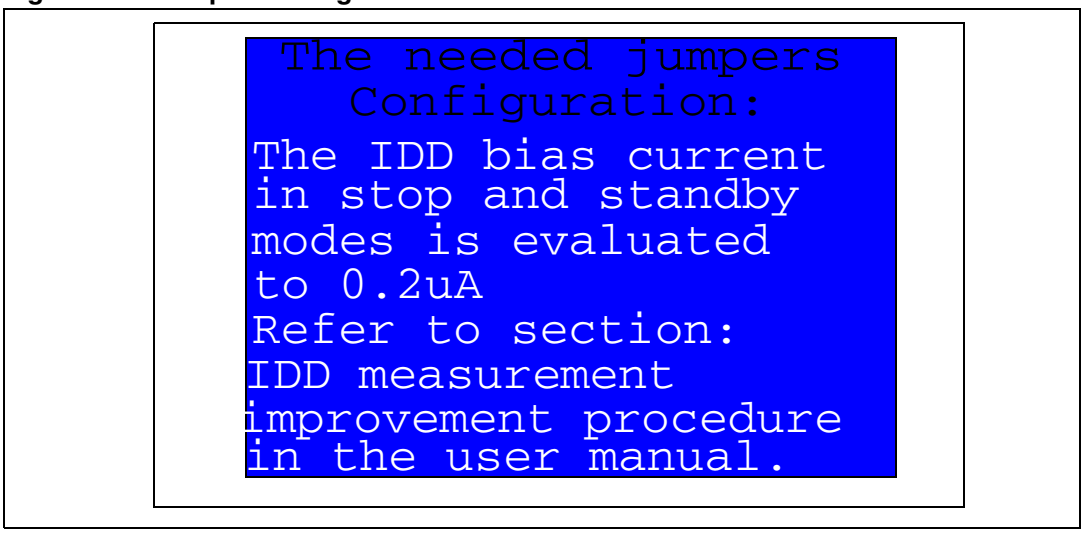


Figure 88. Jumpers config menu-5

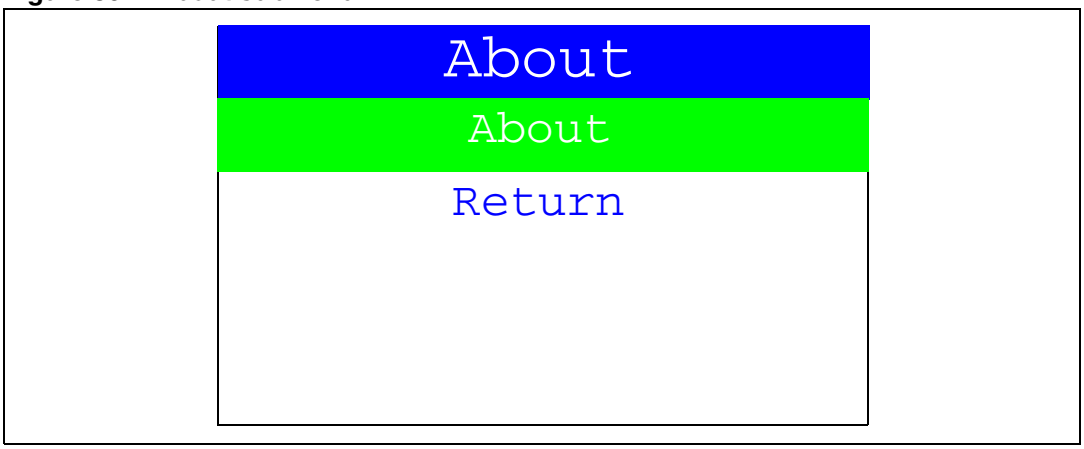


Once the SEL joystick push-button has been pressed, the MCU exits the Jumpers config submenu and the message shown in *Figure 81* is displayed on the LCD screen.

2.4.12 About submenu

This submenu shows the version of the STM32L152ZD demo firmware. When the About submenu is selected, the message shown in *Figure 89* is displayed on the LCD screen.

Figure 89. About submenu

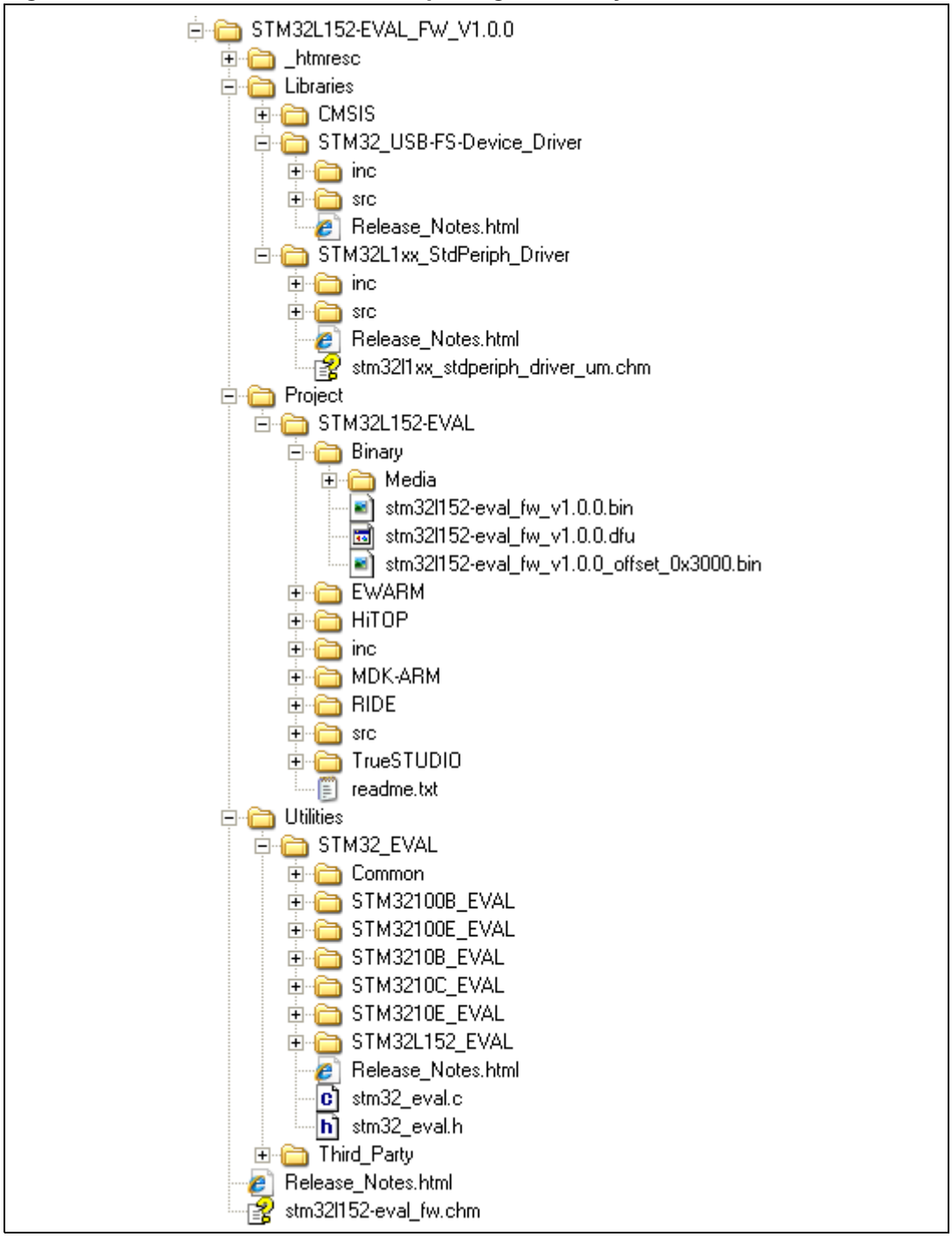


Pressing SEL then displays a message showing the STM32L152D-EVAL demo version on the LCD screen.

3 STM32L152D-EVAL demonstration package

The STM32L152D-EVAL demonstration is supplied in one single zip file. The extraction of the zip file generates one folder, STM32L152D-EVAL_FW_VX.Y.Z, which contains the subfolders shown in *Figure 90* and described below.

Figure 90. STM32L152D-EVAL demo package directory tree



1. **Libraries**: contains all the subdirectories and files that make up the core of the STM32L1xx Standard Peripheral library V1.0.0:

   CMSIS

   – CM3\CoreSupport: contains the Cortex-M3 files

   – CM3\DeviceSupport\ST\STM32L15x: contains the STM32L1xx CMSIS layer files

   STM32L1xx_Stdperiph_Driver

   – *inc* subfolder contains the Standard Peripheral library header files

   – *src* subfolder contains the Standard Peripheral library source files

   STM32_USB-FS-Device_Driver

   – *inc* subfolder contains the USB Full Speed Peripheral library header files

   – *src* subfolder contains the USB Full Speed Peripheral library source files

2. **Project**

   STM32L152D-EVAL

   – Binary: contains the binary image of the demonstration that can be used to program the binary image to the internal Flash memory using IAP, plus the media files required to run the demo (Binary\Media)

   – EWARM: contains preconfigured projects for the EWARM toolchain

   – MDK-ARM: contains preconfigured projects for the MDK-ARM toolchain

   – RIDE: contains preconfigured projects for the RIDE toolchain

   – TrueSTUDIO: contains preconfigured projects for the Atollic toolchain

   – HiTOP: contains preconfigured projects for the HiTOP toolchain

   – inc: contains the Demo header files

   – src: contains the Demo source files

3. **Utilities**

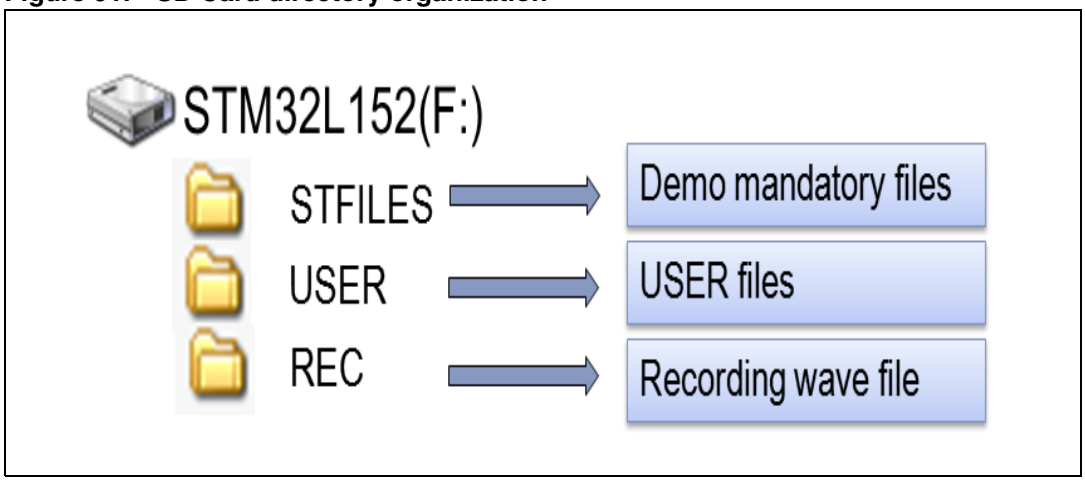
   – STM32L152-EVAL: contains the LCD, and other STM32L152D-EVAL board-related drivers

4 STM32L152D-EVAL demonstration programming

4.1 Programming the media files

The STM32L152D-EVAL board comes with a MicroSD card memory preprogrammed with Audio and Image resources used by the demonstration. However, you can load your own image (*.bmp) and audio (*.wav) files in the USER directory, respectively, provided that these file formats are supported by the demonstration. For more details, please refer to *Section 2.4.3: Image Viewer submenu* and *Section 2.4.4: Wave Player submenu*.

Figure 91. SD Card directory organization



The default content of the media files (STFILES and USER directories) can be retrieved from the Binary\Media folder. If the user wants to reprogram the MicroSD card, he can copy the content of the Binary\Media folder to his/her own SD memory.

4.2 Programming the demo

You can program the demonstration using four methods.

4.2.1 Using Bootloader

To program the demonstration's binary image into the internal Flash memory, you have to use the *stm32l152d_eval_fw_v1.0.0.bin* file located under *Project\STM32L152D-EVAL\Binary* with embedded Bootloader. For more details, please refer to Bootloader application note AN2606 *STM32™ microcontroller system memory boot mode*.

4.2.2 Using IAP

To program the demonstration's binary image into the internal Flash memory, you have to use the *stm32l152d-eval_fw_v1.0.0_offset_0x3000.bin* file located under *Project\STM32L152D-EVAL\Binary* with IAP over USART. For more details, please refer to IAP application note AN3310 *STM32L1xx in-application programming using the USART*.

4.2.3 Using USB DFU

To program the demonstration's binary image into the internal Flash memory, you have to use the *stm32l152d-eval_fw_v1.0.0.dfu* file located under *Project\STM32L152D-EVAL\Binary* with USB DFU. For more details, please refer to user manual UM0424 *STM32 USB-FS-Device development kit*.

4.2.4 Using preconfigured projects

- Select the folder corresponding to your preferred toolchain (MDK-ARM, EWARM, RIDE, TASKING or TrueSTUDIO).
- Open the STM32L152D_EVAL project and rebuild all sources.
- Load the project image through your debugger.
- Restart the evaluation board (press B1: reset button).

5 Revision history

Table 5. Document revision history

Date	Revision	Changes
02-Apr-2012	1	Initial release.

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